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FOREWORD

The rapid development of the stupendous program of national defense in 1941, plus the mounting needs of the democratic nations at war with the Axis Powers, fostered an unprecedented demand for the mineral raw materials that are indispensable to the successful conduct of modern military operations. As soon as this country entered the worldwide conflict in December, the demand for materials became more acute, and at the same time shipments from foreign sources were seriously curtailed. Under the growing pressure for mineral supplies, especially those in which the resources of the United States are deficient, the Bureau of Mines was called upon to exert its efforts to the utmost in the search for domestic sources of the needed minerals, in developing methods for recovering necessary metals from the low-grade ores available in this country, and in supplying accurate, current, and comprehensive data regarding production, distribution, consumption by uses, and stocks of mineral supplies required for military and civil needs. Moreover, the work of the Bureau on health and safety was stepped up to meet the conditions arising from rapid increase in the productive activities of the mineral industries and the additional hazards resulting therefrom.

The achievements of the mining and metallurgical industries in an attempt to meet the tremendous need for mineral supplies constituted a notable contribution to the remarkable progress of the defense program during 1941 The record of the mineral industries in helping to prepare the country for the eventuality of the war forced upon it on December 7, 1941, is presented and analyzed in the present volume of Minerals Yearbook for the information and guidance of Government, industry, and the general public, both in the present and in future years. Although the bound volume of Minerals Yearbook cannot for the present be released for general distribution because of the confidential material it contains relating to strategic and critical minerals, the several chapters covering the other mineral commodities are printed separately and made available for the use of industry and the general public.

Despite the large increase in the volume of inquiries necessarily imposed by Government upon business in the all-out program of preparation for national defense, the response of the mineral industries and other interests to the fact-finding surveys of the Bureau of Mines has been generous and prompt. It is a pleasure to acknowledge here the cordial assistance of the many individuals and agencies furnishing the data that have enabled the Bureau of Mines to compile this comprehensive record of developments in the mineral industries during the important year of 1941. The limits of space preclude mention of the thousands of contributors to this great fund of factual information, but their assistance has been an indispensable factor of the prepared-

ness program. An especially valuable part of this cooperation is that supplied by State officials who have assisted in collecting mineral statistics within their respective jurisdictions, thus eliminating duplication of effort by State and Federal agencies and promoting more accurate statistics. The State agents cooperating in the 1941 canvass were: Stewart J. Lloyd, acting State geologist, University, Ala.; Herman Gunter, State geologist, Tallahassee, Fla.; Garland Peyton, director, division of mines, mining, and geology, department of natural resources, Atlanta, Ga.; M. M. Leighton, chief, and Walter H. Voskuil, mineral economist, State geological survey division, Urbana, Ill.; A. C. Trowbridge, director, Iowa Geological Survey, Iowa City, Iowa; Raymond C. Moore, State geologist, Lawrence, Kans.; Edward B. Mathews, director, department of geology, mines, and water resources, board of natural resources, Baltimore, Md.; R. A. Smith, State geologist, Lansing, Mich.; H. A. Buehler, State geologist, Rolla, Mo.; Meredith E. Johnson, State geologist, Trenton, N. J.; Jasper L. Stuckey, State geologist, Raleigh, N. C.; Robert H. Dott, director, Oklahoma Geological Survey, Norman, Okla.; E. P. Rothrock, State geologist, Vermillion, S. Dak.; E. H. Sellards, director, bureau of economic geology, Austin, Tex.; Arthur Bevan, State geologist, and Linwood H. Warwick, chief clerk, Virginia Geological Survey, Charlottesville, Va.; Harold E. Culver, supervisor, division of geology, department of conservation and development, Pullman, Wash.; Paul H. Price, State geologist, Morgantown, W. Va.; and E. F. Bean, State geologist, Madison, Wis. In addition, B. D. Stewart, Department of Mines, Juneau, Alaska, and Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for Alaska and California, respectively.

R. R. SAYERS, *Director*.

August 31, 1942.

CONTENTS

INTRODUCTION

The great increase in the activities of the mineral industries during 1941 in filling the needs of the national defense and lend-lease programs resulted in new annual production peaks for many important minerals. To supply the increasing demands from defense agencies for current information regarding supplies, distribution, uses, and stocks of the needed mineral commodities, the work of the Bureau of Mines was progressively oriented to service in this field. Of the vast amount of new information thus obtained from producers and consumers of mineral products during 1941, much is included in the present Yearbook.

Because of censorship requirements, considerable confusion and delay have been experienced in preparing Minerals Yearbook, 1941. The compilation of Yearbook material has been delayed further by the loss to Federal war agencies of keymen from the commodity divisions of the Economics and Statistics Service. In May the Department of Commerce ceased to publish data covering the export of specific commodities by countries of destination subsequent to March 31. In the latter part of the year it also ruled that all figures of imports and exports later than those covering September should be withheld from publication.

To provide uniform control over the publication and use of Federal statistical information that would give aid and comfort to the enemy, Executive Order 9103 was issued by the President March 18, 1942; it ordered that

> The Director of the Bureau of the Budget shall maintain a continuous surveillance of governmental publication of statistical data and shall determine in any instance whether the publication of statistical data by any Government agency would be in accordance with governmental policy designed to guard against the unauthorized disclosure of vital information as such policy is formulated by appropriate authority.

The Committee on War Information recommended that the Minerals Yearbook be classified by the Bureau of Mines as "confidential," in the military sense of the term, with a limited number of copies distributed for official use only and the remainder of the edition impounded for the duration of the war. However, upon recommendation of the Bureau of Mines, the Bureau of the Budget agreed that only those sections of the Minerals Yearbook dealing with certain mineral commodities designated as strategic or critical by the Army and Navy Munitions Board should be considered confidential. The separate chapters that discuss strategic or critical minerals only are therefore considered confidential, and their distribution is being restricted to a limited list of authorized users in Federal agencies. In those composite chapters of the Yearbook that cover both strategic and critical minerals and others not in such category, discussion of the former is being restricted to material not of a confidential character, and the chapters will be released for general distribution. All other chapters of the Minerals Yearbook will be released for general distribution and will include the customary statistics, with the exception of

data on imports and exports for the last 3 months of the year and those covering exports by countries of destination since March 31.

As Minerals Yearbook, 1941, contains a great deal of information regarding strategic and critical minerals that cannot be released to the public at this time, the volume is issued upon a confidential basis and will be available only to authorized users in Federal agencies having need for the information it contains. The Yearbook will not be available for general distribution until its contents can be made public without disclosing information of significant military value to the enemy.

It will be noted that the continuity of some of the statistical series regularly carried in the Minerals Yearbook has been interrupted necessarily, but temporarily, because of the Government's policy regarding the disclosure of vital information. These interrupted series will be brought up to date in subsequent issues of the Yearbook when the confidential data omitted herein can be released without giving aid and comfort to the enemy.

Acknowledgments.—The collection of economic and statistical data in relation to the bituminous-coal industry was transferred from the Bureau of Mines to the National Bituminous Coal Commission in 1937. Since that transfer, the Yearbook chapters relating to bituminous coal have been kindly contributed by the Commission and its successor, the Bituminous Coal Division, United States Department of the Interior; this cooperation is gratefully acknowledged.

The data on imports and exports in Minerals Yearbook were obtained through the cooperation of the Bureau of Census, United States Department of Commerce.

The Bureau of Mines depends on the good will and voluntary cooperation of those interested in minerals for the data comprised in its statistical program. It is a pleasure to acknowledge the generous support of thousands of individual mine operators, distributors, and consumers, as well as that received from the many public officials and agencies that have returned questionnaires or otherwise supplied information. The Bureau, furthermore, is indebted to a large number of trade associations for liberal contributions of data.

Credit is accorded the many members of the Bureau's staff who assisted in the preparation, editing, and arrangement of the Yearbook material. Especial mention is due the following members of the staff, who have been most active and assiduous in contributing to the preparation of the Yearbook manuscript for publication. Martha B. Clark, besides preparing the statistical summary of mineral production each year, has been largely responsible for the maintenance of continuity of data and uniformity of statistical presentation throughout the Minerals Yearbook volumes. Mabel E. Winslow acted as editorial consultant and was responsible for the editing of the entire manuscript. The Graphic Section of the Bureau, in Pittsburgh, Pa., Louis F. Perry, chief, prepared most of the charts. Max Abel assisted in administrative details of the Yearbook program and had charge of estimates of space requirements for printing. John H. Ady, chief of the Publications Section of the Interior Department and liaison officer between the Department and the Government Printing Office, contributed invaluable counsel in the development and execution of the publishing program.

F. M. Shore.

August 31, 1942.

PART I. GENERAL SUMMARY

REVIEW OF THE MINERAL INDUSTRIES IN 1941

By E. W. Pehrson

SUMMARY OUTLINE

INTRODUCTION

Mineral production in the United States in 1941 responded to the Nation's mobilization for war by exceeding all previous records. The physical volume of production was 7 percent above the previous peak, established in 1940, 17 percent above the predepression peak of 1929, and 49 percent above production levels of the World War of 1917–18. The output was valued at $6,817,300,000, 21 percent above 1940 but 2 percent under the peak value recorded in 1920. Although mineral prices increased moderately in 1941—approximately 9 percent over 1940—the record shows that they were still below the level of prices in general. A heavy demand for minerals persisted throughout the year and in many instances was unsatisfied by available supplies; as a consequence, civilian uses were substantially curtailed to maintain military production schedules. Industry inventories trended downward, and efforts were made to increase production at home and abroad, particularly in Latin America.

The transition from a defense to a war economy in December 1941 had no immediate effect on the domestic mineral industry other than the added impetus for more production prompted by the realization that the Nation was actually at war. The success of Axis aggression and submarine warfare prior to Pearl Harbor had provoked major problems in maintaining supplies of those minerals normally obtained in quantity from the Eastern Hemisphere, so that with the declaration of war plans for meeting this threat were well advanced. The success of the submarine attack on American shipping off the Atlantic coast and in the Caribbean early in 1942 greatly aggravated the situation,

however; in these circumstances it was inevitable that 1942 would bring more rigid Federal controls in the production and distribution of mineral raw materials, as well as greater emphasis on lessening our dependence on distant supplies by development of marginal resources nearer home.

Extension of Axis control of mineral resources.—The success of the Axis conquest, in the light of the relatively small material resources available to it at the beginning of the war, must be acknowledged as an outstanding achievement for the dictator nations and a major setback for the democracies. Not only have these aggressions mitigated to a considerable extent serious deficiencies in minerals for the Axis, but they have also cut off important sources of supply upon which the United Nations have depended for many years. Before their expansion Germany, Japan, and Italy occupied only 3 percent of the land area of the world, comprised only 10 percent of the population, and controlled not more than 5 percent of the mineral wealth. On July 1, 1942, they dominated 13 percent of the land area, 35 percent of the population, and about a third of the mineral resources, and there was no assurance that their aggression would not extend farther before the tide of victory turned. Control of Australia and the isolation of virtually all of Asia and North Africa could not be ruled out as an impossibility at that time.

The direction of Axis expansion has been influenced to a considerable extent by mineral objectives. Hitler's drive to the southeast and Japan's move to the southwest struck at rich and strategic mineral areas that heretofore have contributed much to the industrial strength of the United Nations. The shutting off of supplies of tungsten and antimony from China and of tin, manganese, and chromite, as well as rubber, manila fiber, and other nonmineral commodities from southeastern Asia already constitutes a serious loss, and if the threatened pincer movement on the Indian Ocean isolates the Asiatic Continent the Allies face the loss of more important sources of manganese and chromite, strategic mica, and flake graphite. Russia's military power has been crippled by the loss of the manganese, iron, and coal industries of the Ukraine. At the same time, the most serious deficiency of the Axis—petroleum—has been alleviated in part by Japan's occupation of Malaya and the Netherlands Indies. Germany has obtained valuable raw materials and facilities for manufacturing munitions in Europe and seeks the rich petroleum prizes of the Near East.

The numerical significance of Axis gains in mineral wealth is illustrated by the accompanying table, which shows the percentage of Axis control of world production and capacity in various commodities before expansion began, as of July 1, 1942, based on battle lines on that date, and the possible control that would result from conquest of Australia and isolation of Asia and North Africa by control of the Indian Ocean and the Mediterranean. The figures are based on production in 1940, the latest year for which reliable estimates can be made. They do not reflect the expansion in production that has occurred since 1940 or the effects of "scorched-earth" activities in occupied countries. Consequently the data can be considered only as an approximate indication of relative mineral strength of the antagonists in the present world conflict.

Growth in Axis control of mineral production resulting from conquest, in percent of world total

Mineral	Before expansion	July 1, 1942	Possible[1]	Mineral	Before expansion	July 1, 1942	Possible[1]
Petroleum	1	7	22	Tin	1	72	74
Refinery capacity	5	11	24	Aluminum	33	54	61
Coal	27	53	59	Bauxite	11	49	62
Iron ore	6	46	55	Magnesium	67	68	72
Steel capacity	20	34	44	Manganese ore	2	30	78
Copper	5	10	20	Chromite	3	30	68
Refinery capacity	11	17	21	Tungsten	6	64	67
Lead	7	22	45	Nickel	1	4	12
Zinc	16	27	44	Mercury	52	68	74
Smelter capacity	10	44	51	Antimony	2	32	34

[1] Assuming Australia, Asia, and North Africa come under Axis domination.

As indicated above, the control over mineral resources so far gained by the Axis cannot be considered as an equivalent gain in military power. For example, tungsten and antimony in the interior of China, not yet occupied by Japanese troops, is largely cut off from the United Nations but is only partly available to the Axis. Restoration of production schedules and transportation in newly conquered territory is at best a difficult job, and doubtless many production facilities have been destroyed under the "scorched-earth" programs of the invaded countries. Occasionally refining capacity has been captured, but raw materials to maintain operations are not available. Many of the European oil refineries are reported to be inactive for want of crude petroleum. Despite these difficulties, the improved mineral position of the Axis countries has strengthened their capacity for war and at the same time aggravated the raw-material problems of the United Nations, in consequence prolonging the duration of the conflict.

These losses in mineral supplies, while indeed serious, are by no means decisive. The industrial war power of the United States and its Allies when fully mobilized will outweigh that of the Axis by a considerable margin. Recently the Government advised the Nation that the United Nations war production already has surpassed that of the Axis but that the program must move forward even faster. Potential supplies of all essential minerals are adequate for this purpose. The United States has substantial stocks of many of the strategic minerals, the less essential civilian uses are being curtailed, and production at home and abroad is being stepped up. The immensity and diversity of the mineral wealth of the Western Hemisphere assure ample raw materials for successful prosecution of the war, if new production can be developed in time. Winning the war is thus chiefly a problem of quickly converting potential mineral output into usable material and of speedy organization and efficient use of manpower and plant to employ these mineral materials in effective military effort before the enemy consolidates its holdings and becomes intrenched in impregnable military positions.

PRODUCTION

Value of mineral output.—In 1941, as in 1940, the quantity of minerals produced exceeded all previous records; but the value failed to reach that of the peak year 1920, when prices of minerals, partic-

ularly coal, were abnormally high. The total value of the mineral output of the United States for 1941, approximately $6,817,300,000, was 2 percent below that of 1920 but exceeded all other years. It was 21 percent over 1940. Average prices in 1941 were roughly 9 percent above those in 1940.

Of the total value of mineral production in 1941, fuels contributed $3,628,900,000 (53 percent), metals $2,137,100,000 (31 percent), and nonmetallics other than fuels $1,051,300,000 (16 percent). The value of metal production increased 27 percent, that of fuels 16 percent, and other nonmetallics 28 percent. Figure 1 shows the growth in value of various branches of mineral production from 1880 to 1941. Up to 1908 metals comprised the principal product in most years, but since then fuels have consistently ranked first except for 1915 and 1916. The predominant position of the mineral fuels during the last three decades has been due largely to the phenomenal growth of the petro-

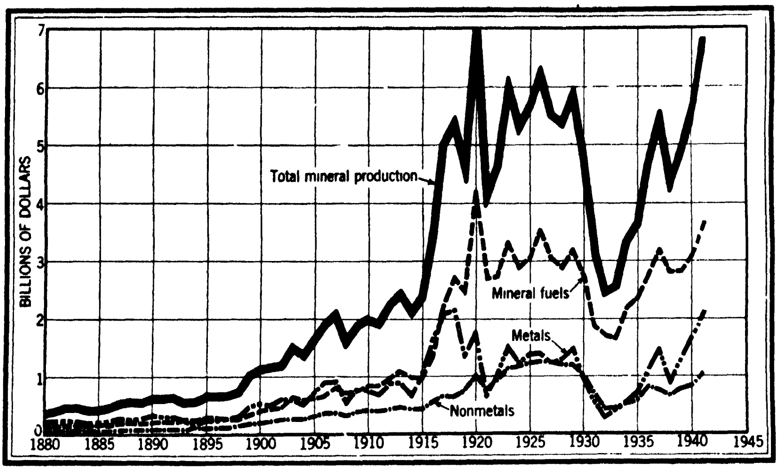

FIGURE 1.—Trends in the value of mineral production in the United States, 1880–1941.

leum and natural-gas industries. In 1941 oil and gas wells contributed products valued at over $2,300,000,000, or 34 percent of the total mineral output.

Trends in physical volume of production.—Figure 2 compares the physical volume of mineral production during the last 42 years with industrial and agricultural production and with population growth, each expressed in terms of an index based on the average for 1935–39.[1] The long-time trend of production during this 42-year period has been steadily upward, although year-to-year and cyclical fluctuations have been prominent. Production of minerals, which furnish tools, fuels, and raw materials for manufacture, has naturally been closely correlated with the trend of industrial production, experiencing the same violent ups and downs, whereas agricultural production has exhibited more moderate fluctuations.

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[1] The following indexes have been used—volume of farm production, U S. Department of Agriculture; mineral production, 1900–18, from Warren Persons' Forecasting Business Cycles; mineral production of 1919–41 and industrial production, Federal Reserve Board; total population of the United States, Bureau of the Census.

The importance of metals in the manufacture of armament and other defense needs is shown by the sharp up-swing of mineral production between 1914 and 1918 and by the all-time high records established in 1940 and 1941 in both mineral and industrial output. Because production of coal for domestic use and petroleum for automobile fuel, which have a pronounced effect on the trend of mineral output, does not respond proportionately to increases in the rate of manufacturing activity and is more stable, the index of industrial production tends to exceed that of mineral production in periods of prosperity and to fall below during depressions. Thus the sharp

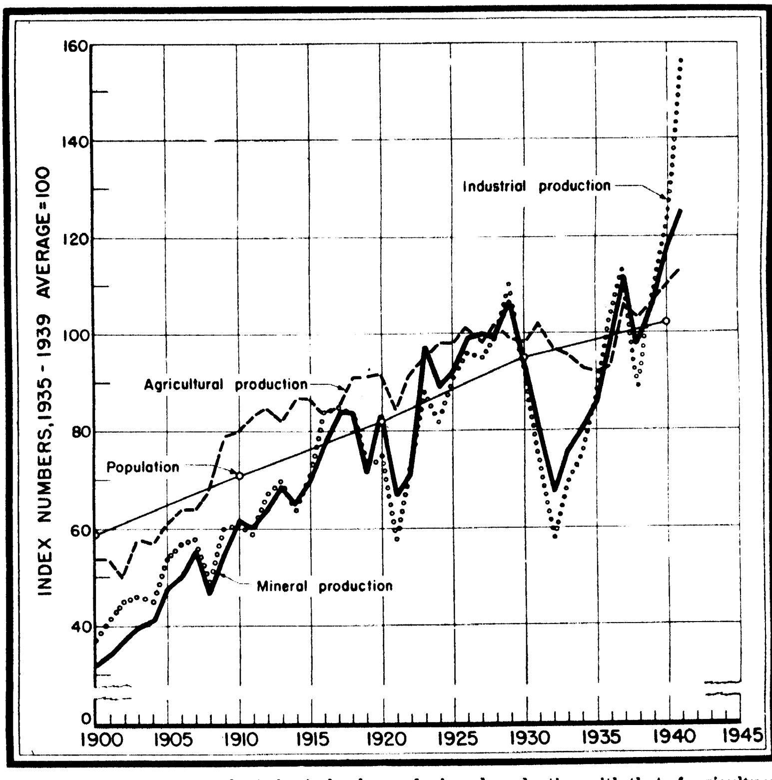

FIGURE 2.—Comparison of growth of physical volume of mineral production with that of agricultural and industrial production and population, 1900–41.

advance of the index of industrial activity over the index of mineral output in 1941 should not be interpreted as a true indication of the lag in mineral output. Such lag as did exist in 1941 was offset in part by larger net imports of mineral raw materials and liquidation of stocks.

STOCKS

Mineral production, particularly of metals, did not pace the rapid increase in manufacture in 1941, and as a consequence inventories trended downward. Industry stocks of copper, lead, and zinc declined during the year, as well as those of manganese, tin, and

mercury. Consumers' stocks of pig iron likewise declined, and the quantity of iron and steel scrap on hand at suppliers' and consumers' plants was considerably lower at the end than at the beginning of 1941. Contrary to the general trend in metal inventories, stocks of tungsten and chromite increased as a result of large importations. Inventories of cement and petroleum decreased somewhat, but those of anthracite and bituminous coal rose appreciably.

Stock-piling activity of the Government was greatly expanded during the year, and the number of commodities being accumulated was increased considerably.

CONSUMPTION

Consumption of minerals exceeded all previous records in 1941, notwithstanding the fact that many less essential civilian uses were curtailed. Despite the frequent cry of shortages, the record shows outstanding increases in consumption to new peaks of virtually all metals and most of the important nonmetallic minerals. Among the metals, iron, copper, lead, zinc, aluminum, magnesium, tin, manganese, chromium, and other alloying elements exceeded former peaks by considerable margins. Domestic demand for petroleum reached a new high at least 55 percent above the 1929 demand. Contrary to the general trend, consumption of anthracite and bituminous coal, though substantially above that in 1940, was still below records set many years ago. The use of cement in 1941 likewise advanced over 1940 but did not equal the predepression high. Other important nonmetallic minerals, however, including raw clay, lime, phosphate rock, salt, sand and gravel, stone, and sulfur, established new peak rates of use in 1941.

The tremendous quantities of minerals consumed in 1941 reflected the rapid rate at which the United States was mobilizing for war. The Federal Reserve Board index of industrial production (1935–39 average=100) again reached a new high by rising from 123 (revised) in 1940 to 156 in 1941. In 1929 the index was 110. Except for a 3-point drop in April, industrial activity continued upward throughout 1941, advancing from 140 (adjusted index) in January 1941 to 168 in December. Aircraft, tanks, ships, guns, and other accouterments of war were substantial contributors to this upward surge; but the abrupt rise in construction, which had lagged behind general industrial activity before 1941, also had an important effect on the demand for minerals. The Federal Reserve Board index of construction contracts awarded (value basis, 1923–25=100) rose from 81 in in 1940 to 122 in 1941—the highest since the peak of 135 established in 1928. However, construction contracts other than residential soared to a peak of 149 compared with 89 in 1940 and 142 in 1929, as a result of the large volume of defense construction inaugurated during the past few years.

PRICES

No precise composite index of average prices of mineral raw materials is available, but a weighted average for 24 major commodities, which comprised approximately 98 percent of the total value of mineral production in 1941, indicates an increase of about 9 percent

in unit sales realizations by producers in 1941 compared with 1940. A somewhat larger rise in fuel and metal prices was offset by only a moderate increase in the unit values of other nonmetallic minerals.

According to the Bureau of Labor Statistics, the wholesale price index (1926=100) of metals and metal products rose from 95.8 in 1940 to 99.4 in 1941. That of nonferrous metals, including some fabricated products, advanced from 81.3 to 84.4. Prices for copper, lead, mercury, tin, and zinc made gains, but that of aluminum dropped again. The index for iron and steel products increased from 95.1 to 96.4; quotations for pig iron and scrap were several points higher, but iron-ore prices again were lower. The fuels were consistent in upward movements. The price index for anthracite rose from 71.7 to 82.7, bituminous coal from 78.9 to 104.3, and petroleum and its products from 50.0 to 57.0. Except for crushed stone, which declined fractionally, building materials (brick and tile, cement, lime, and sand and gravel) recovered somewhat from the lower prices of 1940. Phosphate rock and potash prices likewise rose. The index number of wholesale prices for all commodities increased from 78.6 in 1940 to 87.3 in 1941.

Throughout 1941 mineral prices were under surveillance by the Federal price-control agencies, and much higher prices that would have been justified by supply-demand relationships were avoided, chiefly through voluntary cooperation of the industries. In some instances the Government imposed rigid price ceilings.

Mineral prices in 1941 were still far below previous peaks. The 1941 index for nonferrous metals was 20 percent lower than in 1929 and 42 percent below 1918. The iron and steel index was about 2 percent higher than in 1929 but 34 percent below that in 1918. Prices for petroleum products, although somewhat improved over recent lows, were still 20 percent below 1929 and 58 percent below 1918. The 1941 index for all commodities was 8 percent below 1929 and 34 percent lower than in 1918.

EMPLOYMENT AND SAFETY

Gains in employment noted a year ago for the mineral industries of the United States were continued in 1941; more men were employed at the mines, and more man-hours were worked. Incomplete reports from mines, quarries, mills, smelters, and coke ovens indicate a total of 829,000 men employed, an increase of 27,000 over the number of employees reported for 1940. Even more significant than the increase in number of workers was the increase over 1940 in the number of man-hours worked; the latter amounted to 8 percent and the former to less than 4 percent for all mineral industries combined. Particularly notable were the increases in employment at beehive coke ovens, at mines producing minor but strategic metals such as quicksilver, tungsten, and manganese, and at mines producing such major metals as iron, copper, zinc, and lead. Small gains in man-hours worked were reported for gold lode mines, although gold placer mines reported a decline. Coal mines—both bituminous and Pennsylvania anthracite—also reported more man-hours of work; but these gains, although larger in actual number of man-hours because employment in coal mining is the largest among the various mineral industries, were

proportionately smaller than those at some classes of mines engaged in the production of metallic ores.

Fewer deaths were caused by accidents in the mineral industries of the United States in 1941, but this gratifying decline was offset by an increase in the number of nonfatal injuries. The chief reason for the decline in fatalities was the reduction in deaths from major disasters in coal mines—disasters in which five or more lives are lost. Whereas six major disasters causing 276 deaths in all occurred in 1940, reports for 1941 showed eight disasters with 73 deaths resulting therefrom. This improvement in the major-disaster situation caused the over-all death toll of the mineral industries to drop from 1,716 in 1940 to an estimated 1,620 in 1941. All of the major disasters in 1941 occurred in bituminous-coal mines; none has occurred in a Pennsylvania anthracite mine since June 2, 1938.

The combined fatality rate for all mineral industries in 1941 was 1.16 per million man-hours worked, which compared favorably with a rate of 1.33 for 1940. The corresponding rate for nonfatal injuries was 65.11, as against 64.08 for the previous year. This rise in accident frequency probably resulted from the intense pressure on the mineral industries for production in 1941, which necessitated the employment of inexperienced help at many mines.

Nearly all branches of the mineral industries—such as coal mines, copper mines, iron mines, and limestone quarries—had higher accident-frequency rates in 1941 than in 1940. However, lower and therefore more favorable rates were reported at lead-zinc mines in the Mississippi Valley States, slate quarries, and ore-dressing plants.

On May 7, 1941, Congress enacted a coal-mine inspection law, which, among other things, required the Bureau of Mines to obtain additional information concerning accidents in coal mines. Expanded surveys began April 1, 1942. It is expected that the accident facts now being reported will, under a continuing analysis, prove helpful in achieving the main objectives of the law—namely, the prevention of accidents and the lowering of accident costs that have heretofore been associated with the production of coal in the United States.

Accidents to workers engaged in the production of petroleum—a mineral vital to mechanized warfare—have never been reported systematically. A survey of accident frequency during the calendar year 1941 was begun by the Bureau of Mines in the spring of 1942. Early reports indicate that accidents during 1941 occurred at a rate of 20.21 for each million man-hours of work performed at the producing properties.

NATIONAL DEFENSE ACTIVITY

The progress of World War II, culminating in the declaration by the United States of war against the Axis Powers in December 1941, promoted rapid expansion of the Government's organization for industrial mobilization. A brief summary of activities pertaining to the mineral industry, which appeared in this chapter of Minerals Yearbook—Review of 1940, is carried forward in the following digest of subsequent developments up to about August 1, 1942.

At the beginning of 1941 administration of the mineral aspects of the Government defense program was lodged in a variety of temporary agencies, including the Office for Emergency Management, Office of

Production Management, Advisory Commission to the Council of National Defense, Administrator for Export Control, Office for Coordination of Commercial and Cultural Relations between the American Republics, National Defense Research Committee, Metals Reserve Co., and Defense Plant Corporation. Besides these, the permanent Government agencies had greatly expanded their activity in the mineral field.

The temporary agencies were reorganized during the year to meet changing conditions, and several new ones were created. By the end of 1941 all original functions of the Advisory Commission to the Council of National Defense had been transferred to other agencies, so that the Commission became virtually nonexistent. The Office of the Administrator for Export Control was transferred to a new Economic Defense Board on September 15, 1941, which agency became the Board of Economic Warfare on December 17, 1941. The Office for Coordination of Commercial and Cultural Relations Between the American Republics, formerly part of the National Defense Council, was transferred on July 30, 1941, to the Office for Emergency Management under the title of Office of the Coordinator of Inter-American Affairs. The National Defense Research Committee, created by the Council of National Defense in June 1940, was transferred on June 28, 1941, to the newly organized Office of Scientific Research and Development under the Office for Emergency Management. Another new agency created during 1941 was the Office of Price Administration and Civilian Supply, which on April 11. 1941, absorbed the Price and Consumer Divisions of the National Defense Advisory Commission but on August 28, 1941, was succeeded by the Office of Price Administration, under the Office for Emergency Management; at this time the civilian supply functions were transferred to the Office of Production Management. The Office of Petroleum Coordinator for National Defense (later War) was established on May 28, 1941, with the Secretary of the Interior designated as Coordinator. On November 5, 1941, the Secretary of the Interior also was requested to serve as Coordinator of Solid Fuels. Other agencies created in 1941 with functions more indirectly related to the mineral industries included the National Defense Mediation Board, which was succeeded on December 17, 1941, by the National War Labor Board; Office of Lend-Lease Administration; Supply, Priorities, and Allocations Board; Office of Defense Transportation; Office of Censorship; and others of minor significance to the mineral industries.

Some of the afore-mentioned agencies were created after the declaration of war on December 8, 1941. On January 16, 1942, the War Production Board replaced the Office of Production Management, and the Supply, Priorities, and Allocations Board, which had been set up as a superagency, with Donald M. Nelson as Chief, to determine policy for and coordination of the various activities relating to supply of materials and commodities and their allocation to defense and civilian uses. A War Manpower Commission was established on April 18, 1942, with Paul V. McNutt as Chairman, to formulate plans and programs and establish basic national policies to assure the most effective mobilization and maximum utilization of the Nation's manpower in the prosecution of the war. The labor supply and training functions of the Labor Division of the War Production Board were

transferred to the new agency, as well as related activities of other Government agencies operating in the employment field.

Office for Emergency Management.—This is essentially an administrative agency of the Executive Office designed to maintain liaison between the President and the national war agencies. During 1941 most of the temporary defense and war bureaus were coordinated through the Office for Emergency Management, and by the end of the year all the functions of the Advisory Commission to the Council of National Defense had been transferred to agencies under its jurisdiction.

War Production Board.—At the close of 1941 the Office of Production Management, predecessor of the War Production Board, was operating under the supervision of William S. Knudsen, Director General, and Sidney Hillman, Associate Director General. The organization had been expanded from its original four divisions—Production, Priorities, Purchases, and Labor—to include the following bureaus and divisions:

Bureau of Clearance of Defense Industry Advisory Committees—Sidney J. Weinberg, Chief.
Bureau of Industrial Conservation—Lessing J. Rosenwald, Chief.
Bureau of Research and Statistics—Stacy May, Chief.
Production Division—W. H. Harrison, Chief.
Purchases Division—Douglas MacKeachie, Chief.
Priorities Division—Donald M. Nelson, Chief.
Labor Division—Sidney Hillman, Chief.
Division of Contract Distribution—Floyd B. Odlum, Chief.
Division of Civilian Supply—Leon Henderson, Chief.
Materials Division—W. L. Batt, Chief.

Coincident with the creation of the War Production Board in January 1942, William S. Knudsen was appointed Director of Production for the War Department, with the rank of Lieutenant General. Donald M. Nelson was designated as Chairman of the War Production Board. Other members of the Board as of June 1942 were:

Secretary of War.
Secretary of the Navy.
Federal Loan Administrator.
Lieutenant General in charge of War Department production.
Administrator, Office of Price Administration.
Chairman, Board of Economic Warfare.
Director, Labor Division, War Production Board.
Special Assistant to the President.

A few changes were made in the general organization of the Board. As of June 1942 a Requirements Committee (W. L. Batt, Chairman) and a Planning Committee (Robert R. Nathan, Chairman) had been established in the office of the Board Chairman. The Bureau of Clearance of Defense Industry Advisory Committees, the Priorities Division, and the Division of Contract Distribution were consolidated in a Division of Industry Operations with J. S. Knowlson as Director. The other divisions and bureaus of the original Office of Production Management were continued with relatively minor internal adjustments. A. I. Henderson succeeded W. L. Batt as Chief of the Materials Division, and Wendell Lund replaced Sidney Hillman as Chief of the Labor Division.

Most of the activity of the War Production Board concerned with production and distribution of mineral raw materials was centered in

the Materials Division, in which Dr. C. K. Leith served as technical consultant. As of May 1942, the various branches dealing with minerals and their respective chiefs were as follows:

Mining—Dr. Wilbur Nelson.
Stock Pile and Shipping—Dr. William Y. Elliott.
Aluminum and Magnesium—A. H. Bunker.
Chemicals—Dr. Ernest W. Reid.
Iron and Steel—C. E. Adams.
Power—J. A. Krug.
Cork and Asbestos—Fred W. Gardner.
Nickel—H. A. Rapelye.
Tungsten and Molybdenum—M. K. Smith.
Copper—H. O. King.
Zinc—David A. Uebelacker.
Manganese and Chromite—Andrew Leith.
Tin and Lead—Erwin Vogelsang.
Mica and Graphite—Raymond B. Ladoo.
Miscellaneous Minerals—Richard J. Lund.

Office of Price Administration.—Surveillance and control of mineral and scrap metal prices were greatly increased during 1941 as the gaps between supply and demand widened and pressure on prices mounted. Several warnings were issued during the year to discourage upward trends in prices, and several ceilings were imposed. Before passage of the Emergency Price Control Act of 1942, approved January 30, 1942, the agency functioned only under general executive orders, but passage of the act established definite statutory authority for enforcement of price-stabilization measures. The general policy of the Office of Price Administration has been to pay a premium over fixed ceiling prices for submarginal production rather than to stimulate output by a general advance in price levels. Details on the various actions taken during the year are given in the commodity chapters of this volume.

Control of mineral prices is administered through the Industrial Materials Price Division (Clair Wilcox, Director), the Fuels Price Division (George W. Stocking, Chief), and the Industrial Manufacturing Price Division (Donald Wallace, Director). Donald D. Kennedy heads the Iron and Steel Branch of the Industrial Materials Price Division, John Sumner the Zinc, Lead, and Tin Branch, and Carl Holmquist the Copper, Aluminum, and Ferro-alloys Branch; Jesse L. Maury is Chief Premium Price Analyst for copper, lead, and zinc. R. G. Phelps is Chief of the Chemicals Branch of the Industrial Manufacturing Price Division.

Board of Economic Warfare.—Besides exercising control of all foreign trade in minerals, the Board of Economic Warfare plans Government activities in the procurement, development, and production of minerals required from foreign countries for war purposes. The last function is administered through a Metals and Minerals Division, of which Alan M. Bateman is Chief. The Division is composed of the following sections:

Major Ferro-alloys Section—Robert H. Ridgway, Chief.
Minor Ferro-alloys Section—Hugh E. McKinstry, Chief.
Major Base Metals Section—Herman L. Dauth, Chief.
Minor Base Metals Section—William Warfield, Chief.
Minor and Rare Metals Section—James S. Baker, Chief.
Nonmetallic Mineral Section—Paul M. Tyler, Chief.

As of August 1, 1942, the Board of Economic Warfare had mineral missions in Africa, Argentina, Brazil, Central America, Colombia, Cuba, Guatemala, Mexico, and Peru.

Office of Petroleum Coordinator for War.—This office was authorized by the President to coordinate all Federal activities concerned with the production, refining, transportation, and marketing of petroleum, particularly where these functions pertain to war. It functions as a clearing house for the Federal Government on petroleum matters and operates closely with an Industry War Council, of which W. R. Boyd, Jr., President of the American Petroleum Institute, is Chairman. The organization and major officials of the Office of Petroleum Coordinator for War, as of August 1, 1942, were:

Coordinator—Harold L. Ickes.
Deputy Coordinator—Ralph K. Davies.
Production Division—Don R. Knowlton, Director.
Refining Division—Wright W. Gary, Director.
Transportation Division—J. R. Parten, Director.
Marketing Division—Robert T. Collier, Director.
Natural Gas and Natural Gasoline Division—E. Holley Poe, Director.
Foreign Division—James Terry Duce, Director.
Petroleum Reserves Division—W. B. Heroy, Director.
Petroleum Supply Division—Robert L. Minckler, Director.
Materials Division—Greer W. Orton, Director.
Facility Security Division—W. D. Mason, Director.
Research Division—Edward B. Swanson, Director.
Public Relations Division—Gordon M. Sessions, Director.

Field representation for the Petroleum Coordinator's Office is provided through five district offices and district industry committees with headquarters at New York, N. Y.; Chicago, Ill.; Houston, Tex.; Denver, Colo.; and Los Angeles, Calif.

Office of Solid Fuels Coordinator for War.—This office serves as the agency for the coordination of information and the making of recommendations concerning measures relating to the production, storage, pooling, transportation, distribution, marketing, and consumption of solid fuels for the purpose of assuring adequate supplies at reasonable prices for military, industrial, and civilian needs. As of August 1, 1942, the office was operating under the following administrators:

Coordinator—Harold L. Ickes.
Deputy Coordinator—Howard A. Gray.
Associate Director for Bituminous Coal—Thomas J. Thomas.
Associate Director for Transportation—Ralph P. Russell.
Assistant Director for Anthracite—Brice P. Disque.
Assistant Director for Coke—Harlen M. Chapman.

Bureau of Mines.—Through its field investigations, technical research, health and safety, and economics and statistics services, the Bureau has made valuable contributions to the war program too numerous to mention in detail in this summary. Considerable information on the Bureau's war activity as regards individual commodities is given in the various chapters of this volume. Perhaps the most significant accomplishments are those resulting from the investigation of domestic resources of strategic minerals initiated in 1939 under Public Law 117, 76th Congress, and subsequently extended to other critical minerals. Under this program approximately 1,600 deposits had been investigated up to June 30, 1942. Exploration projects were undertaken on 96 of the most promising, and of these, 56 have proved successful to the extent that tonnages of ore have been developed that are already being brought into production or can be if needed for emergency purposes. The Bureau engineers estimate that the program has indicated 56,000,000 tons of ore of commercial or near-commercial grade in the following categories:

Type of ore	Indicated ore reserves	Approximate grade
	Short tons	
Antimony	2, 241, 600	2 percent antimony.
Chromite	4, 104, 500	20 percent Cr_2O_3
Manganese	10, 239, 900	20 percent manganese
Mercury	1, 053, 100	2 pounds of mercury per ton.
Nickel	8, 406, 700	0 35 percent nickel
Tin	68, 000	6.33 pounds of tin per ton.
Tungsten	1, 094, 200	0 8 percent tungsten
	Long tons	
Iron (Western States)	28, 090, 300	50 percent iron.
	Short tons	
Bauxite	1, 165, 000	40 percent plus Al_2O_3

Geological Survey.—The activities of the Geological Survey have been largely oriented to war work. Its geologic staff is playing an important part in the exploration for war minerals, and its Conservation Branch is aiding in increasing mineral production from public lands. The Survey's map-making and topographic-mapping facilities are working in close cooperation with the military establishments, and its ground-water experts are assisting in solving problems of water supply for military cantonments and munitions plants.

The Survey conducts three types of geological investigations. Regional or district studies of promising areas are made with a view to recommending deposits worthy of further exploration and development by the Bureau of Mines. A second type is carried on by the geologists assigned to Bureau of Mines projects, who assist in planning explorations and interpreting the results. A third type consists of brief examinations of districts or individual deposits for a specific purpose; these usually are requested by some other war agency. The results of this work are published in a series of Strategic Mineral Investigations, of which about 50 had been printed up to June 30, 1942.

Metals Reserve Co.—The Metals Reserve Co., which was transferred from the Federal Loan Agency to the Department of Commerce on February 24, 1942, is the agency through which the Government finances the procurement of mineral supplies and the payment of premium prices. The company is acquiring reserve stocks of various minerals as available supplies permit. In the acquisition and distribution of these materials to industry, the company works in cooperation with the War Production Board, the Office of Price Administration, and the Board of Economic Warfare. Chief administrative officials and mineral advisers include:

Chairman of the Board—Jesse H. Jones.
President—Charles B. Henderson.
Executive vice president—G. Temple Bridgman.
Assistant vice president—Simon D. Strauss.
Technical advisers—H. DeWitt Smith and D. D. Irwin.
Consulting engineer—John E. Norton.
Special adviser—Howland Bancroft.

Defense Plant Corporation.—This agency also was transferred from the Federal Loan Agency to the Department of Commerce on February 24, 1942. The Corporation has very broad authorization, but is chiefly concerned with Government financing of new productive capacity required for war purposes. It operates under directives from the War Production Board, War and Navy Departments. Mineral projects financed by the Corporation include construction

of plants for the production and processing of ores of aluminum, magnesium, chromium, manganese, tungsten, vanadium, and other minerals, as well as steel and pig iron plants. Jesse H. Jones is Chairman of the Board, and Sam H. Husbands is President.

GOVERNMENT STOCK PILES

Government purchasing of minerals for stock piling and for the purposes of price control and stimulation of production has been greatly expanded since January 1, 1941. At that time the Navy Department had completed its small mineral stock-piling program, which included purchases of chromium ore, manganese ore, tin, and tungsten ore. The Procurement Division of the Treasury Department, operating under Public, No. 117, 76th Congress, was actively engaged in acquiring stocks of chromium ore, manganese ore, mercury, mica, quartz crystals, tin, and tungsten ore. Its tin program was completed and purchase of industrial diamonds was inaugurated during the first half of 1941. As stated in Minerals Yearbook, Review of 1940, the need for acceleration and expansion of stock-piling activity became apparent as the war in Europe took a serious turn with the fall of France in May 1940, and this need was met by establishing subsidiary buying organizations in the Reconstruction Finance Corporation of the Federal Loan Agency. With the exception of nitrate of soda, which was acquired by Defense Supplies Corporation, all Reconstruction Finance Corporation metal and mineral purchases have been made through the Metals Reserve Co. As of the close of business September 13, 1941, the Metals Reserve Co. announced it had made commitments to acquire minerals and metals at a cost estimated at $969,544,000.

The extent to which Government purchases have expanded is indicated by the following lists, which show the commodities being acquired at various times:

As of the end of 1940	*Added in 1941*	*Added in January–July 1942*
Antimony	Aluminum (refined)	Alumina
Chromium ore	Asbestos	Alumina hydrate
Graphite	Bauxite	Aluminum (reclaimed)
Manganese ore	Beryllium ore	Antimony ore
Mercury	Cadmium	Arsenic
Mica	Cobalt	Bismuth
Quartz crystals	Copper (refined)	Columbite
Tin	Corundum ore	Copper matte
Tungsten ore	Diamonds, industrial	Copper ore
	Iridium	Cryolite ore
	Iron ore	Fluorspar
	Kyanite	Lead (bullion)
	Lead (refined)	Molybdenite
	Lead ore	Nickel (matte)
	Lead vanadate concentrates	Sapphire (natural Montana)
	Nickel (refined)	Silver (foreign)
	Nitrate of soda	Tantalite
	Platinum	Vanadium ores
	Rutile	Zinc (refined)
	Scrap iron	
	Tin ore	
	Zinc concentrates	
	Zirconium ores	

Details of Government purchases during 1941, insofar as they can be revealed in this volume, are shown in the various commodity chapters.

STIMULATION OF DOMESTIC PRODUCTION

The policy of increasing production of minerals through direct Government contract or subsidy rather than by broadcasting general appeals to the public, as was done during World War I, was continued in 1941. The Government program is carried out chiefly through the Metals Reserve Co. and the Defense Plant Corporation, both subsidiaries of the Reconstruction Finance Corporation. Throughout the year prospective producers or producers desiring to increase their capacity received Government help either through loans or advance contracts guaranteeing a market for fixed tonnages at fixed prices. As an added incentive to stimulate copper, lead, and zinc production and as a means of offsetting rising costs that threatened many producers, a premium-price quota plan for these metals was announced jointly by the Office of Price Administration and the Office of Production Management in January 1942. The plan provided for payment of substantial premiums over established ceiling prices for production in excess of quotas which were determined for each producer according to circumstances surrounding his individual operation. The Metals Reserve Co. participated in the administration of the program.

Early in 1942 it became evident that direct methods of assisting small-scale producers were required, and on March 5, 1942, the Metals Reserve Co. announced a program for buying truckload lots of chromium ore at local buying stations established in Oregon and northern California. Specifications were modified to permit purchase of lower-grade ores, and a fixed schedule of buying prices at purchase depots was published. Subsequently, similar depots were set up in Arizona, Arkansas, Colorado, Montana, Nevada, New Mexico, New York, and Tennessee, and small-lot buying was extended to manganese ore and mercury.

Regulations governing Federal loans to mining also were modified in an endeavor to stimulate domestic production. On March 27, 1942, the Reconstruction Finance Corporation announced that owners or lessees of mining property that gives reasonable promise of success could thereafter obtain development loans repayable out of proceeds from production, rather than secured by mortgage on the property. These loans would be made initially in amounts not exceeding $20,000, but if the results of such development were favorable, additional loans up to $20,000 might be made for further development. Public Law 603, approved June 11, 1942, authorized the Reconstruction Finance Corporation to make loans not to exceed $5,000 to any one borrower for the purpose of financing the unwatering, retimbering, making accessible, or other preliminary development of mine workings, when such loans are deemed by the Reconstruction Finance Corporation to be advantageous to the national defense.

PROCUREMENT OF MINERALS FROM LATIN AMERICA [1]

The impact of war between the United States and the Axis Powers has emphasized the seriousness of the economic problems involved in the necessary shift from our peacetime efforts to sell our products in foreign markets to the wartime necessity of purchasing essential

[1] Contributed by J. S. McGrath.

strategic materials. During 1941 the United States Government and private industry literally combed Latin America to locate additional sources of strategic minerals. Intensive efforts were also made throughout the year by the Governments of most Latin American countries to stimulate production of strategic and critical minerals essential to our war effort in areas already under development. Latin America has been a traditional source of many mineral raw materials, which the United States has in inadequate amounts and consequently has been obliged to import. During the present emergency the United States will depend for a large percentage of its total imports of certain minerals on the other American republics.

In the initial stages of the defense program efforts were made by the Government to purchase essential raw materials from the other American republics. However, the high standards of specifications established by the Army and Navy Munitions Board for stock-pile purchases, the narrow list of commodities listed by the Board, and the comparatively small amount of money originally available for such purposes prevented procurement on a large scale. The buying program, later initiated by the Federal Loan Agency, overcame most of the restrictive features of the original purchasing program, and agreements then entered into between the Government of the United States and several Governments of Latin America during 1941 resulted in a substantial increase in the purchases of several urgently needed raw materials. As requirements for such materials soared, plans were developed for buying all strategic minerals available for export in the several countries of Latin America. During most of 1941 the agreements negotiated had an obvious preclusive element in the sense that such over-all agreements to purchase the entire output of a given country would naturally reduce the amount available to other countries. However, in the negotiations for the purchase of strategic materials, emphasis was placed on the definite requirements of the United States rather than on an effort to obstruct purchases by other countries.

The first over-all agreement to purchase all available minerals was negotiated with Brazil in May 1941. The Federal Loan Agency, through the Metals Reserve Co., agreed to purchase the entire exportable surplus of various Brazilian products for 2 years from the date of the agreement. The mineral products involved included bauxite, beryl ore, chromite, ferronickel, industrial diamonds, manganese, mica, quartz crystals, rutile, and zircon. The list was not rigid, and it was anticipated that other commodities would be added as occasion arose. The agreement embodies a prohibition against the export of the commodities specified except to the United States or to other American republics having parallel systems of export control. However, the Metals Reserve Co. was obligated to buy all the enumerated minerals not purchased by private industry in the United States or by other American republics. The mutual benefits to Brazilian producers and industrial consumers of the United States cannot be fully evaluated at this time, but it is expected that the more stable market assured Brazilian producers for 2 years at relatively high prices will have the effect of increasing output.

An over-all agreement with Mexico became effective on July 15, 1941. The arrangement with Mexico followed the same general pat-

tern as in the case of Brazil. The agreement with Mexico consists of two parts. The Mexican Government established an export embargo to all countries outside the Americas and to countries that have not established export controls similar to Mexico. Among the commodities affected are the following minerals: Antimony, arsenic, bismuth, cadmium, zinc, cobalt, copper, fluorspar, tin, graphite, manganese, mercury, mica, molybdenum, lead, tungsten, and vanadium. The Metals Reserve Co. agreed, during a period of 18 months from the date the joint agreement became effective, to purchase the exportable surplus of the commodities specified, provided the sellers were unable to dispose of their products through regular commercial channels after due effort. There are two notable differences between the Mexican and Brazilian agreements. The Mexican agreement is effective for 18 months while the Brazilian agreement is for 2 years; in the Brazilian agreement purchases will be made at fixed minimum prices, while the Metals Reserve Co. agreed in effect to pay current market prices for such materials as it may buy from Mexico.

In October 1941 arrangements were concluded involving an over-all agreement with the Peruvian Government whereby certain strategic and critical materials were made available exclusively to the countries of the Western Hemisphere, with emphasis on the requirements of the United States. This agreement covers antimony, copper, lead, tungsten, vanadium, and zinc; the Metals Reserve Co. will purchase the entire output of these for the Government stock pile, and it is understood that such purchases will be the surplus over and above purchases made by private industry in the United States.

In May 1941 the Metals Reserve Co. entered into a contract with Bolivian producers guaranteed by the Bolivian Government to purchase the entire production of Bolivian tungsten for the next 3 years at $21 per short-ton unit. Late in 1940 the Metals Reserve Co. contracted with tin-ore producers of Bolivia for annual delivery to the United States during the following 5 years of tin concentrates equivalent to 18,000 tons of refined tin a year; the Bolivian Government guaranteed the performance of this contract.

Other contracts negotiated with Bolivian producers by the Metals Reserve Co provide for the procurement of the entire exportable surpluses of Bolivian antimony, lead, and zinc.

At the close of 1941 negotiations were under way leading toward over-all purchasing agreements involving the mineral output of Argentina and Chile.

When negotiations with other American republics, now under way, have been completed and those already concluded have the anticipated effect, it is apparent that the United States will have virtually the entire exportable surplus of strategic minerals produced throughout Latin America.

STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By MARTHA B. CLARK

SUMMARY OUTLINE

INTRODUCTION

This report continues the series of annual statistical summaries published in previous years as chapters of Mineral Resources and Minerals Yearbook.

UNIT OF MEASUREMENT

The unit of measurement used by the Bureau of Mines for each mineral product in reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value. Although most of the products are measured by weight, some are measured by volume and some by number of "pieces," etc.; for some no total quantity figures are available.

ELIMINATION OF DUPLICATION

In the totals for the United States, shown in the following "general" tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production which is included in the totals. For asphalt, both native and oil are shown in the general tables, but the value of the oil asphalt is excluded from the totals as it duplicates that of the petroleum from which it is manufactured. For the clay industries, no figures have been available for total clay produced. For years before 1936, the total value of clay products is included in both general and State totals as representing the first marketable form of the greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to users of clay are shown separately also, but the value is not included in the totals as it is duplicated largely in that for clay products. For years beginning with 1936, as the Bureau of Mines believes that a closer approach to

the value of domestic clay in its first marketable form results from the inclusion of the value of clay sold by producers and of clay products other than pottery and refractories, the United States and State totals include such values for the clay industries. This change in practice should be borne in mind when comparing the values beginning 1936 with those for earlier years.

United States totals.—In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than the iron ore is included in the United States totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the byproduct sulfuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

State totals.—In the State tables also iron ore and pig iron are both shown. As blast-furnace products cannot be traced to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulfuric acid produced as a byproduct of copper and zinc smelting and zinc roasting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

GENERAL TABLES

Mineral products of the United States, 1939–41 [1]

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value	1941 Quantity	1941 Value
METALLIC						
Aluminum ... pounds	327,090,000	$64,600,000	412,560,000	$75,292,000	(2 3)	(2 3)
Antimonial lead ... short tons (2,000 pounds)	[4] 21,995	(4)	[4] 29,762	(4)	[4] 40,237	(4)
Antimony:						
Metal ... do	(5)	(5)	(5)	(5)	(2 3)	(2 3)
Ore and concentrates ... do	3,174	37,200	1,124	72,900	(2 3)	(2 3)
Bauxite ... long tons (2,240 pounds)	375,301	2,166,236	434,988	2,578,968	(2 3)	(2 3)
Beryllium ore (beryl) ... short tons	95	2,720	121	3,721	158	$7,300
Cadmium:						
Metal ... pounds	5,190,273	2,776,224	6,467,260	4,527,082	7,044,417	5,498,404
In compounds ... do	401,200	212,636	205,900	144,130	265,700	207,246
Chromite ... long tons	3,614	46,892	2,662	28,784	(2 3)	(2 3)
Copper,[6] sales value ... pounds	1,425,349,488	148,236,000	1,818,167,516	205,453,000	1,932,144,953	227,993,000
Ferro-alloys ... short tons	942,101	76,156,588	1,292,660	128,127,810	(2 3)	(2 3)
Gold [7] ... troy ounces	5,611,171	196,391,000	6,003,105	210,108,700	5,976,419	209,174,600
Iron:						
Ore [8] ... long tons	54,827,100	158,537,696	75,198,084	[8] 189,086,799	93,053,994	[8] 249,705,903
Pig ... short tons	35,942,463	626,824,690	46,958,929	840,442,032	55,223,641	1,111,811,316
Lead (refined),[6] sales value ... do	420,967	39,571,000	433,065	43,307,000	470,517	53,639,000
Magnesium (new ingot) ... pounds	10,650,121	(9)	12,823,633	[10] 3,462,380	(2 3)	(2 3)
Manganese ore (35 percent or more Mn) ... long tons	29,307	794,746	40,123	1,169,024	(2 3)	(2 3)
Manganiferous ore (5 to 35 percent Mn) ... do	709,247	2,148,321	1,136,547	3,348,042	(2 3)	(2 3)
Mercury:						
Metal ... flasks (76 pounds net)	18,633	1,936,714	37,777	6,681,618	(2 3)	(2 3)
Ore ... short tons	(11)	(12)	(11)	(12)	(11)	(12)
Molybdenum ... pounds	32,415,000	22,157,000	25,329,000	17,189,000	(2 3)	(2 3)
Nickel ... short tons	394	(9)	554	(9)	(2 3)	(2 3)
Ores (crude), old tailings, etc.:						
Copper ... do	55,221,000	(12)	69,278,000	(12)	78,453,000	(12)
Dry and siliceous (gold and silver) ... do	19,467,000	(12)	18,700,000	(12)	17,639,000	(12)
Lead ... do	5,387,000	(12)	6,144,000	(12)	6,151,000	(12)
Lead-copper ... do	8,000	(12)	10,000	(12)	6,000	(12)
Zinc ... do	7,576,000	(12)	9,521,000	(12)	10,492,000	(12)
Zinc-copper ... do	67,000	(12)	79,000	(12)	81,000	(12)
Zinc-lead ... do	11,518,000	(12)	12,866,000	(12)	16,211,000	(12)
Zinc-lead-copper ... do	12,000	(12)	4,000	(12)	1,000	(12)
Platinum metals (refined) (value at New York City) ... troy ounces	41,441	1,566,000	47,339	1,986,000	(2 3)	(2 3)
Selenium ... pounds	345,726	(9)	368,709	(9)	681,650	(9)

See footnotes at end of table.

Mineral products of the United States, 1939–41—Continued

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value	1941 Quantity	1941 Value
METALLIC—continued						
Silver [13] ... troy ounces	65, 119, 513	$44, 202, 279	69, 585, 734	$49, 483, 189	72, 336, 029	$51, 438, 954
Tantalum ore ... pounds	340	200			250	280
Tellurium ... do	63, 431	([9])	88, 996	([9])	239, 983	([9])
Tin (metallic equivalent) ... short tons	38	38, 400	55	54, 900	([2, 3])	([2, 3])
Titanium ore:						
Ilmenite ... do	([9])	([9])	([9])	([9])	([9])	([9])
Rutile ... do	([9])	([9])	([9])	([9])	([9])	([9])
Tungsten ore (60-percent concentrates) ... do	4, 287	4, 402, 182	5, 319	6, 576, 318	([2, 3])	([2, 3])
Uranium and vanadium ores ... do	279, 354	1, 053, 660	96, 345	1, 018, 600	([2, 3])	([2, 3])
Zinc,[8] sales value ... do	491, 058	51, 070, 000	589, 988	74, 338, 000	652, 599	97, 890, 000
Other metallic [14]		1, 110, 817		1, 162, 558		1, 727, 828
Total value of metallic products (approximate)		1, 291, 700, 000		1, 679, 500, 000		2, 137, 100, 000
NONMETALLIC						
Arsenious oxide ... short tons	22, 439	495, 500	23, 339	561, 300	34, 784	1, 119, 320
Asbestos ... do	15, 459	512, 788	20, 060	674, 508	([2, 15])	([2, 15])
Asphalt:						
Native ... do	459, 848	3, 066, 844	490, 665	2, 725, 337	691, 168	3, 169, 193
Oil (including road oil) [8] ... do	4, 860, 540	[8] 36, 038, 696	5, 262, 959	[8] 41, 398, 735	([2, 8])	([2, 8])
Barite (crude) ... do	383, 609	2, 344, 103	409, 353	2, 596, 743	503, 156	3, 134, 234
Boron minerals ... do	245, 284	5, 689, 797	243, 355	5, 643, 390	301, 282	8, 455, 422
Bromine ... pounds	37, 882, 005	7, 611, 400	59, 266, 275	11, 772, 515	68, 317, 019	11, 506, 213
Calcium-magnesium chloride (75 percent $NaCl_2$) ... short tons	108, 441	1, 307, 717	99, 536	998, 241	165, 932	1, 333, 370
Cement ... barrels (376 pounds net)	125, 056, 594	184, 254, 932	132, 864, 383	193, 464, 869	170, 365, 440	250, 589, 481
Clay:						
Products (other than pottery and refractories) [16]		122, 528, 069		114, 000, 000		([16])
Raw (sold by producers) ... short tons	3, 760, 694	15, 354, 918	4, 700, 951	18, 162, 485	7, 018, 056	25, 193, 893
Coal:						
Bituminous [17] ... do	[18] 394, 855, 325	[18] 728, 348, 366	[19] 460, 771, 500	[19] 879, 327, 227	[19] 511, 290, 000	[19] 1, 083, 935, 000
Pennsylvania anthracite ... do	51, 487, 377	187, 175, 000	51, 484, 640	205, 490, 000	56, 368, 267	240, 275, 000
Coke [8] ... do	44, 326, 641	[8] 212, 884, 050	57, 072, 134	[8] 273, 832, 410	65, 186, 578	[8] 352, 967, 237
Diatomite ... do	([20])	([20])	([20])	([20])	([20])	([20])
Emery ... do	765	6, 828	1, 046	9, 349	4, 876	42, 484
Feldspar (crude) ... long tons	253, 466	1, 112, 857	290, 763	1, 271, 995	338, 860	1, 519, 456
Fluorspar ... short tons	182, 771	3, 704, 959	233, 600	4, 744, 808	320, 669	6, 724, 782
Fuller's earth ... do	167, 070	1, 691, 855	146, 568	1, 471, 083	207, 446	2, 111, 674
Garnet for abrasive purposes ... do	4, 056	278, 534	4, 716	259, 345	5, 501	371, 752
Gems and precious stones		([21])		([21])		([21])
Graphite:						
Amorphous ... short tons	([20])	([20])	([20])	([20])	([2, 15])	([2, 15])
Crystalline ... pounds	([20])	([20])			([2, 15])	([2, 15])

Grindstones and pulpstones ... short tons	10,434	426,375	13,323	496,448	15,536	545,556
Gypsum (crude) ... do	3,226,737	4,431,005	3,699,015	5,227,910	4,788,534	6,704,228
Helium ... cubic feet	[22] 6,281,800	[22] 75,262	[22] 9,450,855	[22] 85,061	([20])	([20])
Iodine ... pounds	([20])	([20])	([20])	([20])	([20])	([20])
Kyanite ... short tons	2,950	69,000	4,241	93,716	8,335	175,581
Lime ... do	4,254,348	30,049,394	4,886,929	33,956,385	6,079,416	42,941,162
Lithium minerals ... do	1,990	97,000	2,011	80,679	3,832	115,718
Magnesite (crude) ... do	198,980	1,465,190	333,166	2,487,969	374,799	2,655,547
Magnesium salts (natural) (including brucite) ... pounds	171,508,000	2,159,019	216,532,000	2,452,814	274,714,000	3,587,784
Marl:						
Calcareous ... short tons	22,114	38,492	25,516	42,481	183,009	175,393
Greensand ... do	6,466	318,550	6,697	389,888	11,120	619,664
Mica:						
Scrap ... do	24,672	311,895	22,386	314,565	([3] [15])	([3] [15])
Sheet ... pounds	813,708	138,963	1,625,437	291,685	([3] [15])	([3] [15])
Millstones	...	11,084	...	6,558	...	15,579
Mineral paints.						
Natural pigments [23] ... short tons	([23])	([23])	([23])	([23])	([23])	([23])
Zinc and lead pigments [24] ... do	162,774	19,029,802	164,775	19,334,347	228,123	27,994,694
Mineral waters ... gallons sold	([21])	([21])	([21])	([21])	([21])	([21])
Natural gas ... M cubic feet	2,476,756,000	534,240,000	2,660,222,000	577,939,000	2,770,000,000	608,000,000
Natural gasoline ... gallons	2,169,300,000	90,050,000	2,339,400,000	68,261,000	2,696,568,000	126,700,000
Oilstones, etc ... short tons	620	115,805	([20])	([20])	([20])	([20])
Olivine ... do	3,000	15,000	2,500	15,000	4,828	24,401
Peat ... do	55,483	362,066	70,097	516,865	86,503	657,556
Petroleum ... barrels (42 gallons)	1,264,962,000	1,294,470,000	1,353,214,000	1,385,440,000	1,404,182,000	1,570,000,000
Phosphate rock ... long tons	3,757,067	12,294,042	4,002,700	12,334,662	4,688,312	15,587,738
Potassium salts ... short tons	[25] 366,287	12,028,195	[25] 393,058	12,562,050	[25] 531,346	17,368,237
Pumice ... do	89,159	424,780	82,407	449,914	117,310	669,514
Pyrites ... long tons	519,497	1,560,000	626,640	1,920,000	659,498	2,035,000
Salt (sodium chloride) ... short tons	9,277,911	24,509,680	10,359,960	26,474,619	12,720,629	33,620,376
Sand and gravel:						
Glass sand ... do	2,468,290	4,280,936	2,759,544	4,881,508	3,475,111	6,113,529
Sand (molding, building, etc.) and gravel ... do	223,540,000	101,785,000	235,548,000	105,806,000	285,240,000	141,093,000
Sand-lime brick [26] ... thousands of brick	153,280	1,587,859	104,519	1,174,044	([26])	([26])
Silica (quartz) ... short tons	34,959	153,038	31,865	176,390	41,685	228,587
Slate ... do	531,380	6,682,214	473,450	5,738,269	618,660	7,515,634
Sodium salts (carbonates and sulfates) (natural) ... do	262,222	2,556,686	317,267	3,157,916	304,201	3,266,123
Stone [27] ... do	147,447,130	158,461,515	153,733,040	160,044,115	183,107,960	195,337,426
Sulfur ... long tons	2,233,817	35,500,000	2,558,742	40,900,000	3,401,410	54,400,000
Sulfuric acid (60° Baumé) (byproduct) [28] ... short tons	778,441	6,213,027	840,937	6,797,421	915,989	7,201,161
Talc, pyrophyllite, and ground soapstone [27] ... do	253,976	2,700,834	281,375	3,008,320	416,369	4,701,892
Tripoli ... do	33,474	466,380	30,212	366,569	29,301	421,746
Vermiculite ... do	21,174	174,587	22,299	137,698	23,438	125,444
Other nonmetallic [29]	...	2,363,251	...	2,806,861	...	4,457,215
Total value of nonmetallic products (approximate)	...	3,622,500,000	...	3,935,300,000	...	4,680,200,000

See footnotes at end of table.

Mineral products of the United States, 1939–41—Continued

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value	1941 Quantity	1941 Value
SUMMARY						
Total value:						
Metallic		$1,291,700,000		$1,679,500,000		$2,137,100,000
Nonmetallic:						
Fuels		2,834,300,000		3,116,500,000		3,628,900,000
Other		788,200,000		818,800,000		1,051,300,000
Grand total approximate value of mineral products		4,914,200,000		5,614,800,000		6,817,300,000

1 In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1941 are subject to revision. For details see following chapters of this volume.
2 Figures withheld from publication at request of Committee for War Information.
3 Value included in total value of metallic products
4 Figures represent antimonial lead produced at primary refineries from both domestic and foreign primary and secondary sources, no figures for value of antimonial lead available. Estimate of value of primary antimony and lead contents of antimonial lead from domestic sources included in total value of metallic products.
5 Largely from foreign ore; value not included in total value.
6 Product from domestic ores only.
7 According to Bureau of the Mint. Valued at $35 per ounce.
8 Value not included in total value
9 Value included in total value of metallic products, Bureau of Mines not at liberty to publish figures.
10 Value calculated at nominal price—27 cents per pound.
11 Figures not available.
12 Figures showing values not available
13 According to Bureau of the Mint.
14 Includes value of following products Figures are shown wherever Bureau of Mines is at liberty to publish them.
1939: Bismuth and iron ore sold for paint (12,235 long tons, $66,817).
1940. Bismuth, cobalt oxide, and iron ore sold for paint (8,912 long tons, $45,578).
1941: Bismuth, cobalt ore, indium, iron ore sold for paint (20,792 long tons, $101,710), and zircon concentrates (174 short tons, $5,153).
15 Value included in total value of nonmetallic products.
16 Figures obtained through cooperation with Bureau of the Census Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete. Figures for 1941 not yet available; estimate of value included in total value of nonmetallic products.
17 Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.
18 According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
19 According to Bituminous Coal Division; value for bituminous includes selling expenses Figures for 1941 are preliminary.
20 Value included in total value of nonmetallic products, Bureau of Mines not at liberty to publish figures.
21 No canvass Estimate of value included in total value of nonmetallic products.
22 Figures cover fiscal year ended June 30 of year stated
23 Canvass discontinued after 1915 Figures for iron ore sold for paint given in footnote 14.
24 Sublimed blue lead, sublimed white lead, lead zinc oxide, and zinc oxide.
25 Equivalent as K_2O.
26 Figures obtained through cooperation with Bureau of the Census. Figures for 1941 not yet available; estimate of value included in total value of nonmetallic products.
27 Figures for soapstone used as dimension stone included in figures for stone.
28 From copper and zinc smelters and zinc roasters and from roasting of high-sulfide gold and silver concentrates.
29 Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.
1939: Andalusite, aplite, natural sulfonated bitumen, calcite (Iceland spar), chats (2,237,200 short tons, $294,200), dumortierite, flint lining for tube mills, optical fluorspar (undetermined quantity, $25), pebbles for grinding, silica sand and sandstone (ground) (310,512 short tons, $1,930,301), and sulfur ore (79 long tons, $743)
1940: Andalusite, aplite, natural sulfonated bitumen, chats (3,786,906 short tons, $572,739), dumortierite, flint lining for tube mills, pebbles for grinding, silica sand and sandstone (ground) (342,218 short tons, $2,088,314), strontium minerals, and sulfur ore (280 long tons, $3,203)
1941 Andalusite, aplite, natural sulfonated bitumen, chats (5,291,491 short tons, $897,940), dumortierite, flint lining for tube mills (3,411 short tons, $54,216), pebbles for grinding (13,561 short tons, $221,826), silica sand and sandstone (ground) (487,665 short tons, $3,073,730), strontium minerals (4,724 short tons, $69,054), and sulfur ore (409 long tons, $2,553).

Value of mineral products of the United States, 1880–1941 [1]

Year	Metallic	Nonmetallic			Grand total
		Fuels [2]	Other	Total	
1880 [1]	$190,881,000	$120,241,000	$56,341,000	$176,582,000	$367,463,000
1881	192,663,000	149,798,000	60,659,000	210,457,000	403,120,000
1882	219,070,000	170,470,000	63,557,000	234,036,000	453,106,000
1883	201,131,000	185,760,000	61,170,000	246,930,000	448,061,000
1884	182,784,000	165,825,000	58,431,000	224,256,000	407,040,000
1885	174,718,000	183,075,000	61,758,000	244,833,000	419,551,000
1886	204,795,000	184,608,000	66,782,000	251,390,000	456,185,000
1887	241,183,000	217,251,000	77,199,000	294,450,000	535,633,000
1888	242,460,000	231,459,000	79,880,000	311,339,000	553,799,000
1889	250,823,000	208,297,000	83,206,000	291,503,000	542,326,000
1890	303,937,000	230,962,000	80,530,000	311,492,000	615,429,000
1891	280,985,000	237,160,000	82,704,000	319,864,000	600,849,000
1892	284,215,000	248,344,000	89,673,000	338,017,000	622,232,000
1893	223,654,000	251,735,000	70,104,000	321,839,000	545,493,000
1894	187,335,000	235,618,000	127,292,000	362,910,000	550,245,000
1895	248,533,000	268,438,000	125,720,000	394,158,000	642,691,000
1896	252,575,000	268,161,000	120,305,000	388,466,000	641,041,000
1897	270,434,000	253,598,000	127,580,000	381,178,000	651,612,000
1898	308,747,000	267,513,000	150,782,000	418,295,000	727,042,000
1899	484,021,000	340,773,000	185,302,000	526,075,000	1,010,096,000
1900	514,232,000	406,376,000	188,328,000	594,704,000	1,108,936,000
1901	493,814,000	442,409,000	218,855,000	661,264,000	1,155,078,000
1902	605,017,000	469,079,000	253,855,000	722,934,000	1,327,951,000
1903	589,253,000	634,226,000	271,902,000	906,128,000	1,495,381,000
1904	501,314,000	584,043,000	273,824,000	857,867,000	1,359,181,000
1905	702,785,000	602,258,000	318,722,000	920,980,000	1,623,765,000
1906	886,280,000	652,398,000	362,202,000	1,014,600,000	1,900,880,000
1907	904,151,000	789,128,000	376,291,000	1,165,419,000	2,069,570,000
1908	550,890,000	716,034,000	324,849,000	1,040,883,000	1,591,773,000
1909	755,092,000	746,204,000	385,811,000	1,132,015,000	1,887,107,000
1910	750,027,000	828,213,000	409,604,000	1,237,817,000	1,987,844,000
1911	681,023,000	835,763,000	407,295,000	1,243,058,000	1,924,081,000
1912	862,191,000	945,541,000	430,062,000	1,375,603,000	2,237,794,000
1913	879,058,000	1,087,843,000	466,644,000	1,554,487,000	2,433,545,000
1914	687,101,000	992,837,000	431,234,000	1,424,071,000	2,111,172,000
1915	993,353,000	972,617,000	428,674,000	1,401,291,000	2,394,644,000
1916	1,622,129,000	1,332,584,000	553,726,000	1,886,310,000	3,508,439,000
1917	2,088,914,000	2,237,837,000	665,745,000	2,903,582,000	4,992,496,000
1918	2,156,588,000	2,736,151,000	647,969,000	3,384,120,000	5,540,708,000
1919	1,361,099,000	2,510,394,000	751,777,000	3,262,671,000	4,623,770,000
1920	1,763,675,000	4,192,910,000	1,024,755,000	5,217,665,000	6,981,340,000
1921	654,700,000	2,703,470,000	780,330,000	3,483,800,000	4,138,500,000
1922	988,100,000	2,737,880,000	921,310,000	3,659,190,000	4,647,290,000
1923	1,511,930,000	3,317,100,000	1,157,470,000	4,474,570,000	5,986,500,000
1924	1,233,370,000	2,898,630,000	1,173,800,000	4,072,430,000	5,305,800,000
1925	1,382,155,000	3,058,680,000	1,236,795,000	4,295,475,000	5,677,630,000
1926	1,405,345,000	3,541,916,000	1,266,339,000	4,808,255,000	6,213,600,000
1927	1,220,633,000	3,060,047,000	1,249,320,000	4,309,367,000	5,530,000,000
1928	1,288,290,000	2,884,962,000	1,211,948,000	4,096,910,000	5,385,200,000
1929	1,480,390,000	3,190,527,000	1,216,683,000	4,407,210,000	5,887,600,000
1930	985,790,000	2,764,500,000	1,014,510,000	3,779,010,000	4,764,800,000
1931	569,790,000	1,892,400,000	704,410,000	2,596,810,000	3,166,600,000
1932	285,875,000	1,743,400,000	432,425,000	2,175,825,000	2,461,700,000
1933	417,065,000	1,383,400,000	754,635,000	2,138,035,000	2,555,100,000
1934	548,934,000	2,233,300,000	543,166,000	2,776,466,000	3,325,400,000
1935	733,130,000	2,330,000,000	586,870,000	2,916,870,000	3,650,000,000
1936	1,081,600,000	2,759,200,000	716,000,000	3,475,200,000	4,556,800,000
1937	1,468,200,000	3,200,500,000	744,700,000	3,945,200,000	5,413,400,000
1938	892,600,000	2,820,300,000	650,300,000	3,470,600,000	4,363,200,000
1939	1,291,700,000	2,834,300,000	788,200,000	3,622,500,000	4,914,200,000
1940	1,679,500,000	3,116,500,000	818,800,000	3,935,300,000	5,614,800,000
1941 [3]	2,137,100,000	3,628,900,000	1,051,300,000	4,680,200,000	6,817,300,000
Grand total	48,519,127,000	87,534,352,000	29,740,410,000	117,274,762,000	165,823,889,000

[1] Figures for earlier years not available.
[2] Coal, natural gas, natural gasoline, petroleum.
[3] Subject to revision.

The sum of the following State totals does not reach the total for the United States given in the preceding table partly because figures for certain of the products included in the United States total are not available by States of origin. This fact is brought out in the opening text of this chapter and in the second table following.

In addition, there are many factors (the more important discussed in the opening text) that account for the disagreement between the sum of the State totals and the grand total for the United States, by products. Chief among these are: (1) The use of iron ore values in State totals and pig iron values in United States total; (2) the use of mine figures for gold, silver, copper, lead, and zinc in the State totals and mint and smelter figures (supplemented by the value of byproduct sulfuric acid from copper and zinc smelting and zinc roasting and the value of zinc and lead pigments made in large part direct from ores) in the United States total; and (3) the inclusion of estimates in the United States total for a few products for which no canvass has been conducted for many years and for which no estimate by States is made.

Many other less important differences are involved, but both State and United States totals are as complete and definite as seems possible with the data available. The practice is consistent from year to year, and it is believed that the reader can determine readily just what minerals are covered by the total concerned.

In every table each mineral produced is listed, and all figures are shown except those that the Bureau of Mines is not at liberty to publish.

Value of mineral products of the United States, 1936–40, by States [1]

State	1936	1937	1938	1939	1940
Alabama	$44, 752, 688	$53, 518, 993	$46, 296, 293	$52, 158, 173	$64, 998, 018
Alaska	23, 737, 714	27, 927, 958	28, 796, 753	25, 673, 566	28, 724, 221
Arizona	60, 532, 996	94, 564, 494	60, 756, 253	75, 087, 930	85, 277, 347
Arkansas	21, 296, 783	25, 578, 393	29, 395, 086	29, 572, 632	37, 479, 135
California	437, 565, 809	476, 880, 603	490, 108, 428	467, 612, 196	455, 672, 038
Colorado	56, 214, 827	67, 338, 548	60, 369, 440	64, 144, 557	63, 188, 421
Connecticut	3, 317, 494	3, 689, 554	3, 059, 688	4, 306, 351	3, 914, 177
Delaware	444, 093	397, 362	320, 621	401, 333	457, 326
District of Columbia	547, 576	522, 687	568, 717	591, 837	640, 480
Florida	12, 973, 243	13, 811, 958	12, 866, 981	13, 060, 453	14, 854, 206
Georgia	11, 756, 592	12, 584, 060	11, 598, 421	14, 633, 655	16, 932, 335
Idaho	29, 965, 964	40, 633, 119	31, 738, 606	33, 138, 452	40, 799, 920
Illinois	117, 916, 128	133, 437, 554	130, 155, 083	210, 798, 331	277, 943, 011
Indiana	52, 281, 539	54, 886, 756	47, 892, 364	53, 884, 995	58, 975, 110
Iowa	28, 359, 140	26, 941, 350	24, 794, 058	25, 170, 181	26, 006, 904
Kansas	121, 689, 562	154, 376, 403	129, 675, 438	122, 959, 513	130, 859, 896
Kentucky	113, 435, 307	127, 423, 680	106, 654, 903	112, 840, 566	131, 974, 410
Louisiana	153, 358, 397	182, 118, 905	172, 306, 761	168, 903, 151	189, 153, 312
Maine	3, 423, 353	4, 129, 391	3, 548, 638	3, 769, 791	4, 374, 976
Maryland	11, 157, 550	10, 634, 854	9, 407, 723	11, 781, 531	12, 605, 171
Massachusetts	7, 559, 253	7, 813, 345	6, 666, 281	8, 242, 956	7, 573, 122
Michigan	100, 646, 492	119, 167, 573	81, 380, 602	116, 088, 154	124, 774, 581
Minnesota	94, 568, 991	152, 107, 070	51, 425, 289	106, 455, 607	128, 571, 690
Mississippi	3, 846, 104	4, 821, 950	5, 209, 547	5, 192, 156	7, 239, 647
Missouri	41, 350, 860	52, 446, 272	39, 560, 739	45, 633, 707	50, 324, 566
Montana	65, 569, 150	82, 086, 815	48, 602, 547	63, 343, 802	79, 487, 873
Nebraska	3, 843, 562	4, 837, 809	4, 028, 712	4, 390, 291	4, 692, 146
Nevada	32, 693, 129	38, 871, 816	27, 031, 281	34, 670, 879	42, 570, 529
New Hampshire	1, 182, 055	1, 219, 869	1, 146, 606	1, 187, 339	1, 065, 337
New Jersey	24, 421, 046	31, 467, 931	24, 408, 545	30, 441, 758	33, 653, 732
New Mexico	45, 942, 006	72, 855, 745	63, 568, 953	69, 987, 797	80, 969, 723
New York	71, 647, 775	77, 665, 874	73, 217, 430	78, 409, 560	76, 119, 505
North Carolina	9, 955, 519	11, 160, 444	14, 959, 228	18, 533, 720	21, 112, 732
North Dakota	2, 902, 453	2, 873, 011	2, 653, 473	2, 689, 627	2, 987, 351
Ohio	122, 684, 043	131, 025, 104	104, 812, 531	120, 681, 969	130, 655, 129
Oklahoma	305, 191, 649	367, 444, 222	272, 860, 078	236, 194, 064	235, 494, 159
Oregon	7, 080, 975	6, 609, 710	7, 536, 408	8, 637, 047	11, 229, 670
Pennsylvania	599, 457, 486	599, 817, 364	472, 773, 327	531, 007, 890	618, 347, 805
Rhode Island	929, 103	862, 710	911, 599	980, 916	994, 997
South Carolina	3, 432, 662	4, 022, 325	4, 364, 034	5, 422, 979	5, 305, 597
South Dakota	23, 221, 620	23, 472, 873	23, 583, 359	24, 813, 621	23, 528, 825
Tennessee	31, 121, 865	34, 893, 847	32, 428, 512	39, 818, 234	42, 683, 407
Texas	638, 643, 488	813, 290, 605	740, 147, 465	701, 972, 035	725, 005, 009
Utah	61, 209, 302	105, 652, 422	59, 236, 355	80, 127, 521	104, 392, 989
Vermont	6, 225, 396	7, 042, 547	6, 439, 552	6, 972, 234	6, 979, 772
Virginia	37, 295, 168	46, 019, 085	42, 370, 169	43, 902, 881	50, 003, 672
Washington	22, 921, 456	26, 658, 257	21, 167, 004	31, 595, 704	28, 090, 188
West Virginia	271, 501, 941	306, 590, 947	254, 995, 309	276, 084, 118	329, 891, 960
Wisconsin	13, 277, 983	15, 239, 524	10, 636, 741	12, 704, 942	13, 553, 683
Wyoming	34, 498, 261	41, 087, 908	37, 364, 363	39, 413, 001	43, 073, 532

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. State totals for 1941 not yet available.

Mineral products of the United States and principal producing States in 1940

Rank in value	Product	Principal producing States [1]: In order of quantity	Principal producing States [1]: In order of value
14	Aluminum	New York, Tennessee, North Carolina, Washington	Rank same as for quantity.
91	Andalusite	Nevada	Do.
(²)	Antimonial lead	Not separable by States	Not separable by States.
81	Antimony ore	Nevada, Idaho, Alaska, California	Alaska, Nevada, Idaho, California.
82	Aplite	Virginia	Rank same as for quantity.
62	Arsenious oxide	Montana, Utah	Do.
58	Asbestos	Vermont, Arizona, Georgia, North Carolina	Do.
	Asphalt:		
41	Native	Texas, Oklahoma, Kentucky, Alabama	Kentucky, Utah, Oklahoma, Texas.
19	Oil	Not separable by States	Not separable by States.
42	Barite (crude)	Missouri, Georgia, Tennessee California	Missouri, Tennessee, Georgia, California.
43	Bauxite	Arkansas, Alabama, Georgia, Virginia	Rank same as for quantity.
94	Beryllium ore (beryl)	South Dakota, Colorado, Maine	Do.
55	Bismuth	Not separable by States	Not separable by States.
97	Bitumen (natural sulfonated)	Utah	Rank same as for quantity.
34	Boron minerals	California	Do.
28	Bromine	North Carolina, Michigan, California, West Virginia	Do.
37	Cadmium	Not separable by States	Not separable by States.
57	Calcium-magnesium chloride	Michigan, West Virginia, California, Ohio	Rank same as for quantity.
8	Cement	Pennsylvania, California, New York, Michigan	Pennsylvania, California, New York, Texas.
60	Chats	Oklahoma, Missouri, Kansas	Rank same as for quantity.
87	Chromite	California, Oregon	Do.
	Clay:		
12	Products (other than pottery and refractories).		Ohio, Pennsylvania, California, Illinois.
24	Raw (sold by producers)	Pennsylvania, Georgia, Ohio, Missouri	Georgia, Pennsylvania, Missouri, Kentucky.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	Pennsylvania, West Virginia, Kentucky, Illinois.
	Pennsylvania anthracite	Pennsylvania	Rank same as for quantity.
84	Cobalt oxide	do	Do.
5	Coke	Pennsylvania, Ohio, Indiana, New York	Do.
7	Copper	Arizona, Utah, Montana, Nevada	Do.
49	Diatomite	California, Washington, Oregon, Nevada	California, Washington, Oregon, Florida.
96	Dumortierite	Nevada	Rank same as for quantity.
90	Emery	New York	Do.
51	Feldspar (crude)	North Carolina, South Dakota, New Hampshire, Colorado	North Carolina, South Dakota, New Hampshire, Connecticut.
11	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Ohio.
92	Flint lining for tube mills	Minnesota	Rank same as for quantity.
36	Fluorspar	Illinois, Kentucky, Colorado, New Mexico	Do.
50	Fuller's earth	Georgia, Texas, Florida, Illinois	Georgia, Florida, Texas, Illinois.
72	Garnet (abrasive)	New York, Vermont, North Carolina, Idaho	Rank same as for quantity.
(³)	Gems and precious stones	No canvass for 1940	No canvass for 1940.
6	Gold	California, Alaska, South Dakota, Nevada	Rank same as for quantity.

98	Graphite: Amorphous	Nevada	Do.
64	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.
35	Gypsum (crude)	New York, Michigan, Iowa, Texas	New York, Michigan, Nevada, Iowa.
79	Helium	Texas	Rank same as for quantity.
65	Iodine (natural)	California	Do.
	Iron.		
9	Ore	Minnesota, Michigan, Alabama, Pennsylvania	Do.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Do
54	Sinter	Tennessee	Do.
78	Kyanite	California, Virginia, Georgia, North Carolina	Do.
18	Lead	Missouri, Idaho, Utah, Montana	Do.
21	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
80	Lithium minerals	South Dakota, California, North Carolina	California, South Dakota, North Carolina.
44	Magnesite (crude)	Washington, California, Texas, Nevada	Washington, California, Nevada, Texas.
38	Magnesium	Michigan	Rank same as for quantity.
45	Magnesium salts (natural)	Michigan, Nevada, California, Washington	Michigan, California, Nevada, Washington.
53	Manganese ore	Montana, Tennessee, Arkansas, Georgia	Montana, Arkansas, Tennessee, Georgia.
39	Manganiferous ore	Minnesota, New Mexico, Michigan, Georgia	Minnesota, New Mexico, Georgia, Montana.
69	Manganiferous zinc residuum	New Jersey	Rank same as for quantity.
	Marl:		
85	Calcareous	Virginia, Wisconsin, West Virginia, Nevada	West Virginia, Wisconsin, Virginia, Nevada.
68	Greensand	New Jersey	Rank same as for quantity.
31	Mercury	California, Oregon, Nevada, Arkansas	Do.
59	Mica	North Carolina, Virginia, South Dakota, Colorado	North Carolina, Connecticut, South Dakota, Virginia.
	Scrap	do	North Carolina, Virginia, Georgia, South Dakota.
	Sheet	North Carolina, Connecticut, New Hampshire, South Dakota	Rank same as for quantity.
93	Millstones		North Carolina, Virginia, New York.
23	Mineral paints (zinc and lead pigments)	Pennsylvania, Illinois, Kansas, Indiana	Rank same as for quantity.
([3])	Mineral waters	No canvass for 1940	No canvass for 1940.
25	Molybdenum	Colorado, Utah, New Mexico, Arizona	Rank same as for quantity.
4	Natural gas	Texas, California, Louisiana, Oklahoma	Texas, California, West Virginia, Louisiana.
16	Natural gasoline	Texas, California, Oklahoma Louisiana	California, Texas, Oklahoma, Louisiana.
71	Nickel	Not separable by States	Not separable by States.
77	Oilstones, etc	Arkansas, Ohio, New Hampshire, Indiana	Rank same as for quantity.
89	Olivine	North Carolina	Do.
([4])	Ores (crude), etc.:		
	Copper	Utah, Arizona, New Mexico, Nevada	Value not available.
	Dry and siliceous (gold and silver)	Alaska, California, Nevada, South Dakota	Do.
	Lead	Missouri, Idaho, Utah, Montana	Do.
	Lead-copper	Utah, Colorado, Idaho, Montana	Do.
	Zinc	Oklahoma, Tennessee, Kansas, New Jersey	Do.
	Zinc-copper	Arizona	Do.
	Zinc-lead	Oklahoma, Kansas, Idaho, Utah	Do.
	Zinc-lead-copper	Utah	Do.
63	Peat	New York, New Jersey, Pennsylvania, Maine	New York, Maine, New Jersey, Michigan.
88	Pebbles for grinding	Minnesota, North Carolina, California	Rank same as for quantity.
1	Petroleum	Texas, California, Oklahoma, Illinois	Do.
27	Phosphate rock	Florida, Tennessee, Idaho, Montana	Do.
47	Platinum metals	Alaska, California, Oregon, Montana	Do.
26	Potassium salts	New Mexico, California, Utah, Maryland	Do.
66	Pumice	Kansas, California, Nebraska, New Mexico	California, Kansas, New Mexico, Nebraska.

See footnotes at end of table.

Mineral products of the United States and principal producing States in 1940—Continued

Rank in value	Product	Principal producing States: In order of quantity	Principal producing States: In order of value
48	Pyrites	Tennessee, Virginia, California, New York	Rank same as for quantity.
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Ohio.
13	Sand and gravel	California, New York, Michigan, Illinois	California, Pennsylvania, New York, Ohio.
52	Sand-lime brick	New York, New Jersey, Michigan, Minnesota	New York, Michigan, New Jersey, Massachusetts.
61	Selenium	Not separable by States	Not separable by States
74	Silica (quartz)	Wisconsin, New Jersey, North Carolina, Tennessee	New Jersey, Wisconsin, North Carolina, California
46	Silica sand and sandstone (ground)	Illinois, New Jersey, West Virginia, Ohio	Illinois, New Jersey, Ohio, West Virginia.
17	Silver	Idaho, Montana, Utah, Colorado	Rank same as for quantity.
33	Slate		Pennsylvania, Vermont, New York, Virginia.
29	Sodium salts (other than NaCl) (natural)	California, Texas, Utah, Wyoming	Rank same as for quantity.
10	Stone	Pennsylvania, Michigan, Ohio, New York	Pennsylvania, New York, Ohio, Illinois.
86	Strontium minerals	Texas, California, Washington, Ohio	Rank same as for quantity.
20	Sulfur	Texas, Louisiana, California, Utah	Do.
30	Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates.	Pennsylvania, Illinois, Tennessee, Arizona	Pennsylvania, Illinois, Tennessee, Oklahoma.
95	Sulfur ore	Texas, Colorado, Nevada	Rank same as for quantity.
40	Talc, pyrophyllite, and ground soapstone [5]	New York, North Carolina, Vermont, California	New York, California, Vermont, North Carolina.
76	Tellurium	Not separable by States	Not separable by States.
83	Tin	Alaska, South Dakota, New Mexico, Montana	Rank same as for quantity.
	Titanium ore		
73	Ilmenite	Virginia, Florida	Do.
67	Rutile	Virginia, Arkansas, Florida	Do.
70	Tripoli	Missouri, Illinois, Arkansas, Oklahoma	Illinois, Missouri, Arkansas, Oklahoma.
32	Tungsten ore	California, Nevada, Colorado, Arizona	Rank same as for quantity.
56	Uranium and vanadium ores	Colorado, Utah	Do.
75	Vermiculite	Montana, North Carolina, Wyoming, Texas	Montana, North Carolina, Wyoming, Colorado
15	Zinc	Oklahoma, New Jersey, Idaho, Kansas	Rank same as for quantity.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available.
[3] No canvass for 1940.
[4] Value not available.
[5] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

States and their principal mineral products in 1940 [1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	18	1.39	Coal, iron ore, cement, stone.
Alaska	29	.62	Gold, platinum metals, coal, silver.
Arizona	14	1.82	Copper, gold, silver, zinc.
Arkansas	27	.80	Petroleum, coal, natural gas, bauxite.
California	3	9.75	Petroleum, natural gas, gold, natural gasoline.
Colorado	19	1.35	Coal, molybdenum, gold, silver.
Connecticut	45	.08	Stone, clay products, sand and gravel, feldspar.
Delaware	50	.01	Clay products, stone, sand and gravel, raw clay.
District of Columbia	49	.01	Clay products, stone.
Florida	35	.32	Phosphate rock, stone, cement, sand and gravel.
Georgia	34	.36	Stone, raw clay, clay products, cement.
Idaho	26	.87	Silver, lead, zinc, gold.
Illinois	5	5.95	Petroleum, coal, stone, cement
Indiana	20	1.26	Coal, cement, stone, petroleum
Iowa	31	.56	Coal, cement, stone, clay products
Kansas	9	2.80	Petroleum, natural gas, zinc, coal.
Kentucky	8	2.82	Coal, natural gas, petroleum, stone
Louisiana	7	4.05	Petroleum, natural gas, sulfur, salt
Maine	44	.09	Stone, sand and gravel, cement, clay products
Maryland	37	.27	Coal, sand and gravel, cement, clay products.
Massachusetts	39	.16	Stone, sand and gravel, clay products, lime.
Michigan	12	2.67	Iron ore, petroleum, cement, copper.
Minnesota	11	2.75	Iron ore, manganiferous ore, stone, sand and gravel.
Mississippi	40	.16	Petroleum, natural gas, clay products, sand and gravel.
Missouri	21	1.08	Lead, cement, coal, stone
Montana	16	1.70	Copper, gold, silver natural gas.
Nebraska	43	.10	Cement, sand and gravel, stone, clay products
Nevada	25	.91	Copper, gold, silver, tungsten ore
New Hampshire	47	.02	Stone, sand and gravel, clay products, feldspar.
New Jersey	28	.72	Zinc, clay products, sand and gravel, iron ore.
New Mexico	15	1.73	Petroleum, copper, natural gas, potassium salts.
New York	17	1.63	Cement, petroleum, stone, natural gas
North Carolina	33	.45	Bromine, stone, clay products, sand and gravel.
North Dakota	46	.06	Coal, sand and gravel, clay products, stone
Ohio	10	2.80	Coal, clay products, natural gas, stone.
Oklahoma	6	5.04	Petroleum, natural gas, zinc, natural gasoline.
Oregon	38	.24	Gold, stone, mercury, cement
Pennsylvania	2	13.23	Coal, natural gas, petroleum, cement.
Rhode Island	48	.02	Stone, sand and gravel, clay products, lime.
South Carolina	42	.11	Clay products, stone, raw clay, gold
South Dakota	32	.50	Gold, stone, cement, sand and gravel
Tennessee	24	.91	Coal, stone, cement, zinc.
Texas	1	15.51	Petroleum, natural gas, sulfur, natural gasoline.
Utah	13	2.23	Copper, gold, silver, coal.
Vermont	41	.15	Stone, slate, asbestos, lime.
Virginia	22	1.07	Coal, stone, cement, clay products.
Washington	30	.60	Cement, coal, sand and gravel, gold.
West Virginia	4	7.06	Coal, natural gas, petroleum, stone.
Wisconsin	36	.29	Stone, iron ore, sand and gravel, cement
Wyoming	23	.92	Petroleum, coal, natural gas, natural gasoline.

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis.

Prices of gold, silver, copper, lead, and zinc, 1932–41 [1]

Year	Gold [2]	Silver [3]	Copper [4]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[5] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[6] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[6] .646+	.098	.046	.048
1939	35.00	[7] .678+	.104	.047	.052
1940	35.00	[8] .711+	.113	.050	.063
1941	35.00	[8] .711+	.118	.057	.075

[1] Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ per fine ounce. For table of prices for silver, copper, lead, and zinc from 1850 to 1931, by years, see Mineral Resources, 1931, pt. 1, p. A115.

[2] 1932: Legal coinage value; 1933–34: Yearly average weighted Government price; 1935–41: Price under authority of Gold Reserve Act of January 31, 1934.

[3] 1932–33: Average New York price for bar silver; 1934 and 1938–41: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver

[4] Yearly average weighted price of all grades of primary metal sold by producers.

[5] $20.671835. [6] $0.64646464. [7] $0.67878787. [8] $0.71111111.

STATE TABLES

Mineral production of Alabama, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asphalt (native)......short tons..	(1)	(1)	(1)	(1)
Barite......do....	(1)	(1)		
Bauxite......long tons..	(1)	(1)	(1)	(1)
Cement......barrels..	[2] 5,042,921	[2] $6,690,765	[2] 5,249,759	[2] $7,617,405
Clay:				
Products (other than pottery and refractories)...		[3] 2,306,712		[3] 2,394,000
Raw (sold by producers)......short tons..	51,015	83,933	144,354	143,363
Coal......do....	[4] 12,046,675	[4] 27,741,791	[5] 15,324,163	[5] 35,777,923
Coke......do....	3,854,505	[6] 10,917,559	4,727,378	[6] 13,748,837
Ferro-alloys......do....	31,440	[6] 1,802,917	45,184	[6] 3,422,111
Gold......troy ounces..	3	105	5	175
Iron.				
Ore......long tons..	5,985,208	9,971,024	7,330,412	12,606,369
Pig......short tons..	3,043,602	[6] 43,902,681	3,476,072	[6] 49,706,851
Lime......do....	176,513	1,004,785	234,147	1,359,371
Manganese ore......long tons..	187	3,742	243	(1)
Manganiferous ore......do....	519	4,561	342	(1)
Mica:				
Scrap......short tons..			(1)	(1)
Sheet......pounds..			(1)	(1)
Mineral waters......gallons sold..	(7)	(7)	(7)	(7)
Ore (dry and siliceous) (gold and silver).short tons..	10	(8)	900	(8)
Sand and gravel......do....	1,283,577	687,265	1,840,945	936,724
Silver......troy ounces..			3	2
Stone......short tons..	1,855,990	2,516,584	2,496,480	3,048,043
Miscellaneous [9]......		1,146,906		1,114,643
Total value, eliminating duplications......		52,158,173		64,998,018

[1] Value included under "Miscellaneous."
[2] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division, value includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" and "2" above.

Mineral production of Alaska, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)......short tons..	(1)	(1)	(1)	(1)
Arsenic......do....	(2)	(2)	(2)	(2)
Coal......do....	[3] 146,250	[3] $585,000	[3] 173,970	[3] $695,000
Copper......pounds..	256,000	26,624	110,000	12,430
Gold......troy ounces..	676,737	23,685,795	755,970	26,458,950
Lead......short tons..	937	88,078	779	77,900
Mercury......flasks (76 pounds)..			162	28,653
Ores (crude), etc.:				
Copper......short tons..	165	(4)		
Dry and siliceous (gold and silver)......do....	4,751,492	(4)	4,885,023	(4)
Platinum metals (crude)......troy ounces..	31,300	997,000	32,300	1,093,000
Sand and gravel......short tons..	[5] 42,332	[5] 23,112	515,011	103,217
Silver......troy ounces..	201,054	136,473	191,679	136,305
Stone......short tons..	(1)	(1)	(1)	(1)
Tin (metallic equivalent)......do....	37	37,300	52	52,000
Miscellaneous [6]......		94,184		66,766
Total value, eliminating duplications......		25,673,566		28,724,221

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] According to the Alaskan Branch of the Geological Survey.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Arizona, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)...short tons..			(1)	(1)
Arsenious oxide...do....	(2)	(2)	(2)	(2)
Asbestos...do....	904	$95,807	1,197	$149,290
Barite...do....	(1)	(1)		
Bismuth...pounds..			(2)	(2)
Clay:				
Products (other than pottery and refractories)...		[3] 237,542		[3] 306,000
Raw (sold by producers)...short tons..	(1)	(1)	(1)	(1)
Coal...do....	(1, 4)	(1, 4)	(1, 5)	(1, 5)
Copper...pounds..	524,224,000	54,519,296	562,338,000	63,544,194
Feldspar (crude)...long tons..	(1)	(1)	(1)	(1)
Fluorspar...short tons..	(1)	(1)	(1)	(1)
Gems and precious stones...		(6)		(6)
Gold...troy ounces..	316,453	11,075,855	294,807	10,318,245
Gypsum (crude)...short tons..	(1)	(1)		
Lead...do....	10,771	1,012,474	13,266	1,326,600
Lime...do....	57,233	448,860	67,882	502,998
Manganese ore...long tons..			369	4,940
Mercury...flasks (76 pounds)..	(1)	(1)	740	130,884
Mica, scrap...short tons..	(1)	(1)	(1)	(1)
Molybdenum...pounds..	711,192	(1)	406,306	(1)
Ores (crude), etc.:				
Copper...short tons..	17,468,926	(7)	20,284,826	(7)
Dry and siliceous (gold and silver)...do....	1,042,004	(7)	928,448	(7)
Lead...do....	9,778	(7)	8,813	(7)
Lead-copper...do....	30	(7)	44	(7)
Zinc...do....	670	(7)		
Zinc-copper...do....	67,074	(7)	79,044	(7)
Zinc-lead...do....	204,778	(7)	271,000	(7)
Sand and gravel...do....	655,155	261,316	245,602	114,500
Sand-lime brick...thousands of brick..	(1, 8)	(1, 8)	(1, 8)	(1, 8)
Silica (quartz)...short tons..	(1)	(1)	(1)	(1)
Silver...troy ounces..	7,824,004	5,310,839	7,075,215	5,031,264
Stone...short tons..	665,290	626,281	1,149,000	1,043,101
Sulfuric acid [9]...do....	(1, 10)	(1, 10)	(1, 10)	(1, 10)
Tungsten ore (60-percent concentrates)...do....	100	103,980	349	471,546
Vanadium from complex ore...	(1)	(1)	(1)	(1)
Zinc...short tons..	6,711	697,944	15,456	1,947,456
Miscellaneous [11]...		1,183,915		798,684
Total value, eliminating duplications...		75,087,930		85,277,347

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals
[8] Figures obtained through cooperation with Bureau of the Census.
[9] From copper smelting.
[10] Value not included in total value for State.
[11] Includes minerals indicated by "1" above.

Mineral production of Arkansas, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Barite ... short tons			(1)	(1)
Bauxite ... long tons	361, 256	$2, 074, 954	423, 283	$2, 501, 393
Cement ... barrels	(1)	(1)	(1)	(1)
Clay.				
Products (other than pottery and refractories)		[2] 944, 661		[2] 792, 780
Raw (sold by producers) ... short tons	(1)	(1)	24, 997	13, 845
Coal ... do	[3] 1, 152, 038	[3] 3, 655, 438	[4] 1, 453, 611	[4] 4, 879, 286
Gems and precious stones		(5)		(5)
Lead ... short tons			55	5, 500
Lime ... do	(1)	(1)	(1)	(1)
Manganese ore ... long tons	5, 365	(1)	6, 079	(1)
Manganiferous ore ... do	1, 970	(1)	1, 075	(1)
Mercury ... flasks (76 pounds)	364	37, 834	1, 159	204, 992
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	10, 107, 000	1, 996, 000	14, 379, 000	2, 622, 000
Natural gasoline ... gallons	24, 634, 000	962, 000	32, 096, 000	818, 000
Oilstones ... short tons	(1)	(1)	(1)	(1)
Ores (crude), etc				
Lead ... do	(6)	(7)	(6)	(7)
Zinc ... do	(6)	(7)	(6)	(7)
Petroleum ... barrels	21, 238, 000	16, 790, 000	25, 775, 000	21, 700, 000
Sand and gravel ... short tons	2, 646, 793	1, 030, 270	2, 664, 178	1, 068, 701
Slate		(1)		(1)
Stone ... short tons	641, 460	640, 330	1, 222, 690	1, 152, 328
Titanium minerals Rutile ... do	(1)	(1)	(1)	(1)
Tripoli ... do	(1)	(1)	(1)	(1)
Zinc ... do	123	12, 792	440	55, 440
Miscellaneous [8]		1, 428, 353		1, 664, 870
Total value, eliminating duplications		29, 572, 632		37, 479, 135

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value but a number of them included such expenses.
[4] According to Bituminous Coal Division value includes selling expenses.
[5] No canvass.
[6] Figures not available.
[7] Not valued as ore, value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

Mineral production of California, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Andalusite short tons	([1])	([1])		
Antimony ore (concentrates) do	([1])	([1])	74	$3,700
Arsenious oxide do	([2])	([2])	([2])	([2])
Asphalt (native) do	([1])	([1])	([1])	([1])
Barite do	([1])	([1])	([1])	([1])
Boron minerals do	244,984	$5,685,297	243,355	5,643,390
Bromine pounds	([1])	([1])	([1])	([1])
Calcium chloride short tons			([1])	([1])
Cement barrels	11,293,989	15,889,395	13,813,362	17,296,522
Chromite long tons	3,514	([1])	([1])	([1])
Clay:				
Products (other than pottery and refractories)		[3] 8,304,038		[3] 8,417,000
Raw (sold by producers) short tons	310,710	894,809	343,526	926,633
Copper pounds	8,360,000	869,440	12,876,000	1,454,988
Diatomite short tons	([1])	([1])	([1])	([1])
Feldspar (crude) long tons	2,076	12,655	2,711	18,254
Fuller's earth short tons	([1])	([1])		
Gems and precious stones		([4])		([4])
Gold troy ounces	1,435,264	50,234,240	1,455,671	50,948,485
Gypsum (crude) short tons	188,364	306,350	259,321	437,504
Iodine pounds	([1])	([1])	([1])	([1])
Iron ore long tons	17,173	([1])	1,071	([1])
Kyanite short tons	([1])	([1])	([1])	([1])
Lead do	526	49,444	1,772	177,200
Lime do	87,407	833,326	112,522	1,031,352
Lithium minerals do	([1])	([1])	([1])	([1])
Magnesite do	([1])	([1])	([1])	([1])
Magnesium salts (natural) pounds	([1])	([1])	([1])	([1])
Manganese ore long tons	6	([1])	158	([1])
Manganiferous ore do			87	([1])
Marl, calcareous short tons	([1])	([1])		
Mercury flasks (76 pounds)	11,127	1,156,540	18,629	3,294,911
Mica, scrap short tons	([1])	([1])	([1])	([1])
Mineral paints (zinc and lead pigments) do	([1, 5])	([1, 5])	([1, 5])	([1, 5])
Mineral waters gallons sold	([4])	([4])	([4])	([4])
Molybdenum pounds	([1])	([1])	([1])	([1])
Natural gas M cubic feet	348,361,000	91,572,000	351,950,000	90,006,000
Natural gasoline gallons	607,237,000	35,454,000	587,476,000	27,901,000
Ores (crude), etc.:				
Copper short tons	367,477	([6])	446,392	([6])
Dry and siliceous (gold and silver) do	5,209,637	([6])	4,214,650	([6])
Lead do	706	([6])	8,199	([6])
Lead-copper do			11	([6])
Zinc-lead do	33	([6])	181	([6])
Peat do	4,199	22,240	4,116	21,110
Pebbles for grinding do	([1])	([1])	([1])	([1])
Petroleum barrels	224,354,000	229,000,000	223,881,000	216,720,000
Platinum metals (crude) troy ounces	1,140	([1])	1,400	([1])
Potassium salts short tons	([1])	([1])	([1])	([1])
Pumice do	36,216	144,772	32,123	152,885
Pyrites long tons	([1])	([1])	([1])	([1])
Salt (sodium chloride) short tons	404,689	1,980,777	469,354	2,200,640
Sand and gravel do	13,661,406	6,711,214	18,913,301	8,988,894
Sand and sandstone (ground) do	([1])	([1])	5,505	39,080
Silica (quartz) do	([1])	([1])	([1])	([1])
Silver troy ounces	2,599,139	1,764,264	2,359,776	1,678,063
Slate		([1])		([1])
Sodium salts (carbonates and sulfates) (natural) short tons	209,398	1,988,929	233,590	2,183,110
Stone do	5,734,100	4,673,751	6,340,080	5,048,242
Strontium minerals do			287	4,282
Sulfur long tons	([1])	([1])	([1])	([1])
Sulfuric acid [7] short tons	([1, 5])	([1, 5])	([1, 5])	([1, 5])
Talc, pyrophyllite, and ground soapstone do	33,796	483,839	36,282	476,926
Titanium ore: Ilmenite do	([1])	([1])		
Tripoli do	([1])	([1])	([1])	([1])
Tungsten ore (60-percent concentrates) do	1,263	1,140,597	2,070	2,561,042
Zinc do	6	624	79	9,954
Miscellaneous [8]		8,589,243		8,155,536
Total value, eliminating duplications		467,612,196		455,672,038

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] No canvass.
[5] Value not included in total value for State.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] From roasting of high-sulfide gold and silver concentrates.
[8] Includes minerals indicated by "1" above.

Mineral production of Colorado, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Arsenious oxide.........short tons..	(1)	(1)	(1)	(1)
Barite.........do....	(2)	(2)	(2)	(2)
Beryllium ore (beryl).........do....	(2)	(2)	(2)	(2)
Bismuth.........pounds..	....	....	(1)	(1)
Cement.........barrels..	(2)	(2)	(2)	(2)
Clay:				
Products (other than pottery and refractories)..	....	[3] $1,687,568	....	[3] $1,391,000
Raw (sold by producers).........short tons..	128,391	150,803	115,670	156,588
Coal.........do....	[4] 5,923,210	[4] 14,620,726	[5] 6,588,742	[5] 16,644,265
Coke.........do....	454,869	(2, 6)	605,965	(2, 6)
Copper.........pounds..	26,430,000	2,748,720	24,304,000	2,746,352
Feldspar (crude).........long tons..	29,995	107,536	34,105	123,514
Ferro-alloys.........short tons..	(2, 6)	(2, 6)	(2, 6)	(2, 6)
Fluorspar.........do....	7,569	107,459	11,032	163,285
Fuller's earth.........do....	(2)	(2)	(2)	(2)
Gems and precious stones.........	....	(7)	....	(7)
Gold.........troy ounces..	366,852	12,839,820	367,336	12,856,760
Gypsum (crude).........short tons..	24,013	40,694	24,641	36,787
Iron, pig.........do....	(2, 6)	(2, 6)	(2, 6)	(2, 6)
Lead.........do....	8,222	772,868	11,476	1,147,600
Lime.........do....	10,699	103,097	7,944	82,486
Manganese ore.........long tons..	....	....	224	(2)
Manganiferous ore.........do....	7,516	(2)	3,303	(2)
Mica, scrap.........short tons..	(2)	(2)	(2)	(2)
Mineral waters.........gallons sold..	(7)	(7)	(7)	(7)
Molybdenum.........pounds..	25,437,893	(2)	18,600,897	(2)
Natural gas.........M cubic feet..	2,015,000	467,000	2,533,000	573,000
Natural gasoline.........gallons..	390,000	13,000	380,000	14,000
Ores (crude), etc.:				
Copper.........short tons..	342,499	(8)	334,312	(8)
Dry and siliceous (gold and silver).........do....	1,542,235	(8)	1,528,737	(8)
Lead.........do....	14,700	(8)	10,199	(8)
Lead-copper.........do....	1,464	(8)	1,037	(8)
Zinc.........do....	344	(8)	27	(8)
Zinc-lead.........do....	13,351	(8)	283,453	(8)
Peat.........do....	(2)	(2)	(2)	(2)
Petroleum.........barrels..	1,404,000	1,330,000	1,626,000	1,480,000
Pumice.........short tons..	....	....	(2)	(2)
Pyrites.........long tons..	(2)	(2)	14,473	34,697
Salt.........short tons..	(2)	(2)	(2)	(2)
Sand and gravel.........do....	[9] 627,306	[9] 361,747	1,853,359	508,403
Silver.........troy ounces..	8,496,488	5,767,313	9,710,709	6,905,393
Stone.........short tons..	900,460	1,040,579	1,089,650	1,067,788
Sulfur ore.........long tons..	36	400	89	1,000
Tungsten ore (60-percent concentrates)..short tons..	479	488,628	693	822,988
Uranium and vanadium ores.........do....	85,225	(2)	92,745	(2)
Vermiculite.........do....	(2)	(2)	(2)	(2)
Zinc.........do....	1,830	190,320	5,060	637,560
Miscellaneous [10].........	....	29,192,106	....	25,105,109
Total value, eliminating duplications.........	....	64,144,557	....	63,188,421

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[10] Includes minerals indicated by "2" and "9" above.

Mineral production of Connecticut, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $1,257,049		[1] $1,007,612
Raw (sold by producers) ... short tons	(2)	(2)	(2)	(2)
Coke ... do	(2 3)	(2 3)	(2 3)	(2 3)
Feldspar (crude) ... long tons	10,033	53,120	24,404	128,348
Lime ... short tons	(2)	(2)	(2)	(2)
Mica:				
Scrap ... do	213	3,483	300	4,900
Sheet ... pounds	279,508	59,172	285,690	40,316
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Peat ... short tons	(2)	(2)	(2)	(2)
Sand and gravel ... do	1,988,933	773,163	1,646,870	736,317
Stone ... do	1,816,650	2,077,366	1,915,990	1,918,132
Miscellaneous [5]		3,053,600		3,342,258
Total value, eliminating duplications		4,306,351		3,914,177

[1] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[2] Value included under "Miscellaneous."
Value not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "2" above.

Mineral production of Delaware, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $185,632		[1] $200,000
Raw (sold by producers) ... short tons	(2)	(2)	(2)	(2)
Sand and gravel ... do	102,850	61,556	[3] 167,138	[3] 91,913
Stone ... do	(2)	(2)	114,690	152,313
Miscellaneous [4]		154,145		13,100
Total value, eliminating duplications		401,333		457,326

[1] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[2] Value included under "Miscellaneous."
[3] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[4] Includes minerals indicated by "2" above.

Mineral production of the District of Columbia, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Stone ... short tons			(1)	(1)
Miscellaneous		$591,837		$640,480
Total value, eliminating duplications		591,837		640,480

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.

Mineral production of Florida, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Cement ....barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...		[2] $193,110		[2] $153,000
Raw (sold by producers).........short tons..	(1)	(1)	(1)	(1)
Diatomite........do....	(1)	(1)	(1)	(1)
Ferro-alloys........do....	(1 3)	(1 3)	(1 3)	(1 3)
Fuller's earth........do....	(1)	(1)	(1)	(1)
Lime........do....	22,843	215,472	25,038	227,440
Mineral waters........gallons sold.	(4)	(4)	(4)	(4)
Peat........short tons..	(1)	(1)	(1)	(1)
Phosphate rock........long tons..	2,678,784	7,893,457	2,845,012	7,741,177
Sand and gravel........short tons..	1,015,139	779,708	1,162,075	800,085
Stone........do....	[5] 1,444,100	[5] 1,462,730	[5] 2,880,540	[5] 2,750,017
Titanium minerals:				
Ilmenite........do....			(1)	(1)
Rutile........do....			(1)	(1)
Miscellaneous [6]........		2,517,786		3,190,127
Total value, eliminating duplications........		13,060,453		14,854,206

[1] Value included under "Miscellaneous "
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of dimension unclassified stone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "3" above.

Mineral production of Georgia, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Asbestos........short tons..	(1)	(1)	(1)	(1)
Barite........do....	86,589	$438,378	92,302	$464,590
Bauxite........long tons..	(1)	(1)	(1)	(1)
Cement........barrels..	(1)	(1)	(1)	(1)
Clay.				
Products (other than pottery and refractories)...		[2] 2,375,225		[2] 2,582,000
Raw (sold by producers)........short tons..	534,214	4,162,127	595,010	4,859,826
Coal........do....	(1 3)	(1 3)	[4] 42,307	[4] 100,570
Copper........pounds..			25,200	2,848
Fuller's earth........short tons..	(1)	(1)	(1)	(1)
Gems and precious stones........		(5)		(5)
Gold........troy ounces .	670	23,450	961	33,635
Graphite, amorphous........short tons..	(1)	(1)		
Iron ore—				
Shipped to furnaces, etc........long tons..	25,846	51,078	100,342	182,613
Sold for paint........do....	487	2,063	944	3,144
Kyanite........short tons..	(1)	(1)	(1)	(1)
Lime........do....	6,815	57,663	13,774	92,281
Manganese ore........long tons..	2,646	45,171	3,572	68,508
Manganiferous ore........do....	7,156	35,959	10,293	63,761
Mica:				
Scrap........short tons..	(1)	(1)	(1)	(1)
Sheet........pounds .	(1)	(1)	(1)	(1)
Mineral waters........gallons sold..	(5)	(5)	(5)	(5)
Ore (dry and siliceous) (gold and silver).short tons.	730	(6)	6,963	(6)
Sand and gravel........do....	328,173	146,355	490,136	231,591
Silver........troy ounces..	58	39	630	448
Slate........		(1)		(1)
Stone........short tons..	1,988,530	4,838,623	2,507,600	5,034,288
Talc and ground soapstone........do....	20,090	177,881	20,104	219,959
Miscellaneous [7]........		2,279,643		2,992,273
Total value, eliminating duplications........		14,633,655		16,932,335

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

Mineral production of Idaho, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates) .... short tons..	2,677	(1)	302	$18,100
Arsenious oxide .... do....	(2)	(2)	(2)	(2)
Bismuth .... pounds..	(2)	(2)	(2)	(2)
Cement .... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)..	....	[3] $102,071	....	[3] 82,000
Raw (sold by producers) .... short tons..	(1)	(1)	(1)	(1)
Coal .... do....	(1 4)	(1 4)	(1 5)	(1 5)
Copper .... pounds..	5,032,000	523,328	6,698,000	756,874
Diatomite .... short tons..	(1)	(1)	(1)	(1)
Garnet, abrasive .... do....	....	....	(1)	(1)
Gems and precious stones	....	(6)	....	(6)
Gold .... troy ounces..	116,662	4,083,170	146,480	5,126,800
Lead .... short tons..	90,981	8,552,214	104,834	10,483,400
Lime .... do....	(1)	(1)	(1)	(1)
Manganiferous ore .... long tons..	163	(1)	313	(1)
Mercury .... flasks (76 pounds)..	(1)	(1)	(1)	(1)
Ores (crude), etc.:				
Copper .... short tons..	1,416	(7)	4,931	(7)
Dry and siliceous (gold and silver) .... do....	784,426	(7)	878,993	(7)
Lead .... do....	125,964	(7)	164,508	(7)
Lead-copper .... do....	....	....	232	(7)
Zinc .... do....	144	(7)	101	(7)
Zinc-lead .... do....	1,196,495	(7)	1,507,922	(7)
Phosphate rock .... long tons..	95,451	431,938	99,088	441,598
Sand and gravel .... short tons..	1,617,856	622,240	1,943,723	657,848
Silver .... troy ounces..	17,222,370	11,690,336	17,552,240	12,481,593
Stone .... short tons..	1,863,350	1,238,735	967,900	809,797
Tungsten ore (60-percent concentrates) .... do....	228	(1)	260	(1)
Zinc .... do....	47,549	4,945,096	70,601	8,895,726
Miscellaneous [8]	....	949,324	....	1,046,184
Total value, eliminating duplications	....	33,138,452	....	40,799,920

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division, value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

Mineral production of Illinois, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Cement .... barrels	[1] 4,801,292	[1] $7,056,746	[1] 4,937,127	[1] $7,209,431
Clay:				
Products (other than pottery and refractories)	....	[2] 7,107,144	....	[2] 7,052,000
Raw (sold by producers) .... short tons	126,611	271,737	169,938	419,740
Coal .... do	[4] 46,782,691	[3] 76,680,593	[4] 50,610,430	[4] 85,584,043
Coke .... do	1,884,240	[5] 11,963,932	3,014,840	[5] 18,217,939
Ferro-alloys .... do	....	....	([5] [6])	([5] [6])
Fluorspar .... do	75,257	1,638,693	104,698	2,313,747
Fluorspar, optical .... ounces	([7])	25	....	....
Fuller's earth .... short tons	([8])	([8])	([8])	([8])
Iron, pig .... do	3,203,846	[5] 57,718,814	4,093,623	[5] 73,882,065
Lead .... do	308	28,952	1,508	150,800
Lime .... do	147,729	1,064,154	161,358	1,150,113
Mineral paints (zinc and lead pigments) .... do	([5] [6])	([5] [6])	([5] [6])	([5] [6])
Mineral waters .... gallons sold	([8])	([8])	([8])	([8])
Natural gas .... M cubic feet	2,746,000	1,450,000	8,359,000	1,557,000
Natural gasoline .... gallons	4,012,000	229,000	21,499,000	805,000
Ores (crude), etc.:				
Lead .... short tons	....	....	50	([9])
Zinc .... do	....	....	60	([9])
Zinc-lead .... do	([10])	([10])	41,830	([9])
Petroleum .... barrels	94,912,000	101,200,000	147,647,000	156,500,000
Pyrites .... long tons	13,950	([6])	13,021	21,876
Sand and gravel .... short tons	[11] 8,755,193	[11] 4,686,487	[11] 10,103,214	[11] 5,578,309
Sand and sandstone (ground) .... do	91,645	543,761	106,397	628,488
Sand-lime brick .... thousands of brick	([6] [12])	([6] [12])	....	....
Silver .... troy ounces	675	458	4,766	3,389
Stone .... short tons	8,420,120	7,820,589	[13] 9,209,170	[13] 7,556,497
Sulfuric acid (60° Baumé) [14] .... do	178,144	[5] 1,665,077	188,355	[5] 1,721,565
Tripoli .... do	11,134	148,310	11,521	155,576
Zinc .... do	334	34,736	4,818	607,068
Miscellaneous [15]	....	3,712,410	....	3,410,794
Total value, eliminating duplications	....	210,798,331	....	277,943,011

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] Value included under "Miscellaneous."
[7] Quantity undetermined.
[8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] No ore milled in northern Illinois in 1939; metal output of southern Illinois was byproduct of fluorspar milling.
[11] "Commercial" Value of "Government-and-contractor" included under "Miscellaneous."
[12] Figures obtained through cooperation with Bureau of the Census.
[13] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[14] From zinc smelting.
[15] Includes minerals indicated by "1", "6", "11", and "13" above.

Mineral production of Indiana, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $5,629,014		[2] $4,265,000
Raw (sold by producers) ... short tons	57,795	79,693	89,230	92,712
Coal ... do	[3] 16,942,772	[3] 25,101,972	[4] 18,868,572	[4] 28,810,864
Coke ... do	4,878,033	[5] 28,532,944	6,412,716	[5] 37,308,469
Gold ... troy ounces	4	140	5	175
Iron, pig ... short tons	3,780,364	[5] 68,164,618	5,333,915	[5] 97,407,809
Lime ... do	94,741	534,688	84,462	457,621
Mineral paints (zinc and lead pigments) ... do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	791,000	452,000	1,137,000	661,000
Petroleum ... barrels	1,711,000	1,675,000	4,978,000	5,200,000
Pyrites ... long tons	4,403	(1)	2,734	4,887
Rubbing stones and whetstones ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	6,249,169	3,388,297	6,265,163	3,306,165
Sand-lime brick ... thousands of brick	(1 7)	(1 7)	(1 7)	(1 7)
Stone ... short tons	[8] 4,338,690	[8] 7,469,659	[8] 4,498,490	[8] 5,822,006
Miscellaneous [9]		11,985,673		12,636,594
Total value, eliminating duplications		53,884,995		58,975,110

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State
[6] No canvass.
[7] Figures obtained through cooperation with Bureau of the Census.
[8] Exclusive of dimension sandstone in 1939 and of unclassified stone in 1940, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Iowa, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement ... barrels	4,717,295	$7,771,503	4,597,781	$7,641,163
Clay:				
Products (other than pottery and refractories)		[1] 3,698,611		[1] 3,649,000
Raw (sold by producers) ... short tons	5,615	50,939	10,005	51,267
Coal ... do	[2] 2,947,557	[2] 7,189,245	[3] 3,231,177	[3] 8,060,587
Ferro-alloys ... do	(4 5)	(4 5)	(4 5)	(4 5)
Gypsum (crude) ... do	430,712	510,120	487,379	587,223
Iron, pig ... do	(4 5)	(4 5)	(4 5)	(4 5)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Peat ... short tons	(4)	(4)	2,500	30,000
Sand and gravel ... do	[7] 2,503,988	[7] 1,299,449	[7] 3,464,803	[7] 1,852,285
Stone ... do	6,400,590	4,385,234	4,013,740	3,832,070
Miscellaneous [8]		2,176,129		2,880,942
Total value, eliminating duplications		25,170,181		26,006,904

[1] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[2] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value included under "Miscellaneous."
[5] Value not included in total value for State.
[6] No canvass.
[7] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[8] Includes minerals indicated by "4" and "7" above.

Mineral production of Kansas, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)		
Cement barrels	[2] 3,746,370	[2] $5,614,112	[2] 3,441,612	[2] $5,192,160
Chats short tons	50,000	(1)	163,180	25,747
Clay:				
Products (other than pottery and refractories)		[3] 1,051,349		[3] 1,035,000
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Coal do	[4] 2,674,691	[4] 5,057,992	[5] 3,578,952	[5] 6,717,318
Gypsum (crude) do	(1)	(1)	(1)	(1)
Lead do	13,697	1,287,518	11,927	1,192,700
Mineral paints (zinc and lead pigments) do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Natural gas M cubic feet	80,556,000	29,356,000	90,003,000	31,931,000
Natural gasoline gallons	62,175,000	1,999,000	64,691,000	1,295,000
Ores (crude), etc.:				
Lead short tons			2,000	(8)
Zinc do	1,937,000	(8)	1,137,704	(8)
Zinc-lead do	1,764,300	(8)	2,014,096	(8)
Petroleum barrels	60,703,000	63,100,000	66,139,000	68,700,000
Pumice short tons	41,643	123,163	39,215	129,959
Pyrites long tons	9,838	(1)		
Salt short tons	641,752	2,591,934	684,053	2,710,847
Sand and gravel do	1,934,759	822,305	2,264,871	893,962
Stone do	3,406,640	4,550,560	2,880,930	3,672,644
Zinc do	68,971	7,172,984	57,032	7,186,032
Miscellaneous [9]		2,797,911		2,760,184
Total value, eliminating duplications		122,959,513		130,859,896

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division, value includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore, value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" and "2" above.

Mineral production of Kentucky, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Clay				
Products (other than pottery and refractories)		[2] $1,566,982		[2] $1,258,000
Raw (sold by producers) short tons	247,958	1,004,232	345,023	1,328,644
Coal do	[3] 42,556,568	[3] 74,078,412	[4] 49,140,904	[4] 91,153,768
Coke do	(1 5)	(1 5)	(1 5)	(1 5)
Fluorspar do	89,563	1,773,063	103,939	2,043,866
Iron, pig do	259,273	(1 5)	290,610	(1 5)
Lead do	87	8,178	360	36,000
Lime do	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	47,771,000	20,630,000	53,056,000	22,936,000
Natural gasoline gallons	7,785,000	347,000	9,539,000	350,000
Ores (lead and zinc) short tons	(7)	(7)	(7)	(7)
Petroleum barrels	5,621,000	5,900,000	5,188,000	5,400,000
Sand and gravel short tons	1,101,415	777,602	1,226,325	815,688
Stone do	4,802,280	4,480,098	4,620,750	4,207,875
Zinc do	909	94,536	1,278	161,028
Miscellaneous [8]		8,850,839		10,740,370
Total value, eliminating duplications		112,840,566		131,974,410

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Figures not available.
[8] Includes minerals indicated by "1" above.

Mineral production of Louisiana, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $741,692		[2] $540,000
Raw (sold by producers) ... short tons	(1)	(1)	10,189	96,314
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	294,370,000	53,835,000	343,191,000	63,577,000
Natural gasoline ... gallons	94,090,000	3,329,000	113,741,000	2,552,000
Petroleum ... barrels	93,646,000	98,000,000	103,584,000	107,500,000
Salt ... short tons	1,072,540	2,830,331	1,132,594	2,804,406
Sand and gravel ... do	2,145,793	1,195,049	2,580,478	1,381,044
Sand-lime brick ... thousands of brick	(1 4)	(1 4)		
Stone ... short tons	(1)	(1)	(1)	(1)
Sulfur ... long tons	446,242	(1)	543,004	8,688,064
Miscellaneous [5]		8,972,079		2,014,484
Total value, eliminating duplications		168,903,151		189,153,312

[1] Value included under "Miscellaneous"

[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete

[3] No canvass.

[4] Figures obtained through cooperation with Bureau of the Census.

[5] Includes minerals indicated by "1" above

Mineral production of Maine, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Beryllium ore (beryl) ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $371,629		[2] $275,000
Raw (sold by producers) ... short tons	(1)	(1)		
Feldspar (crude) ... long tons	18,109	74,165	18,390	84,796
Gems and precious stones		(3)		(3)
Lime ... short tons	(1)	(1)	(1)	(1)
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Peat ... short tons	1,267 [4]	26,569	8,173	118,897
Sand and gravel ... do	3,312,164	888,646	3,836,131	878,820
Silica (quartz) ... do	644	1,725	160	538
Slate		215,951		286,660
Stone ... short tons	[4] 205,280	[4] 1,228,930	[4] 245,580	[4] 1,876,198
Miscellaneous [5]		962,176		854,067
Total value, eliminating duplications		3,769,791		4,374,976

[1] Value included under "Miscellaneous."

[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimated by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete

[3] No canvass.

[4] Exclusive of unclassified stone, value for which is included under "Miscellaneous"

[5] Includes minerals indicated by "1" and "4" above.

Mineral production of Maryland, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asbestos......short tons..	(1)	(1)	(1)	(1)
Cement......barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...		[2] $1,709,524		[2] $1,856,000
Raw (sold by producers)......short tons..	35,817	124,502	49,036	114,531
Coal......do....	[3] 1,442,728	[3] 2,938,938	[4] 1,503,433	[4] 3,171,243
Coke......do....	1,578,973	(1 5)	1,682,701	(1 5)
Feldspar (crude)......long tons..	(1)	(1)	(1)	(1)
Gold......troy ounces..	71	2,485		
Iron, pig......short tons..	2,021,690	(1 5)	2,350,773	(1 5)
Lime......do....	59,504	396,201	63,745	355,771
Mineral waters......gallons sold.	(6)	(6)	(6)	(6)
Ore (dry and siliceous) (gold and silver)..short tons..	220	(7)		
Potassium salts......do....	(1)	(1)	(1)	(1)
Sand and gravel......do....	3,311,029	2,827,268	3,426,525	2,763,322
Silica (quartz)......do....	515	8,010	(1)	(1)
Silver......troy ounces..	2	1		
Slate......		(1)		(1)
Stone......short tons..	1,024,130	1,327,830	1,109,960	1,395,373
Talc and ground soapstone......do....	(1)	(1)	(1)	(1)
Miscellaneous [8]......		40,697,718		46,596,893
Total value, eliminating duplications......		11,781,531		12,605,171

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimated by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

Mineral production of Massachusetts, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)...		[1] $866,226		[1] $976,895
Raw (sold by producers)......short tons..	(2)	(2)	(2)	(2)
Coke......do....	1,057,158	(2 3)	1,130,311	(2 3)
Diatomite......do....	(2)	(2)		
Iron, pig......do....	(2 3)	(2 3)	(2 3)	(2 3)
Lime......do....	111,734	1,005,485	108,797	965,333
Manganiferous ore......long tons..	649	(2)	1,900	(2)
Mineral waters......gallons sold..	(4)	(4)	(4)	(4)
Peat......short tons..	(2)	(2)	703	3,495
Sand and gravel......do....	3,562,098	1,718,929	3,563,760	1,681,222
Sand and sandstone (ground)......do....	1,374	6,220	1,425	6,240
Sand-lime brick......thousands of brick..	(1 2)	(1 2)	(1 2)	(1 2)
Silica (quartz)......short tons..	442	2,652	786	4,716
Stone......do....	2,543,730	4,459,797	2,176,340	3,819,708
Miscellaneous [5]......		8,383,674		9,436,083
Total value, eliminating duplications......		8,242,956		7,573,122

[1] Figures obtained through cooperation with Bureau of the Census
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "2" above.

Mineral production of Michigan, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Bromine .... pounds	13,035,667	$2,680,591	14,173,936	$2,878,900
Calcium chloride .... short tons	98,287	1,219,581	84,918	900,801
Cement .... barrels	8,327,479	10,891,978	8,519,416	11,389,191
Clay:				
Products (other than pottery and refractories)	....	[1] 2,550,934	....	[1] 2,377,000
Raw (sold by producers) .... short tons	(2)	(2)	(2)	(2)
Coal .... do	[3] 456,754	[3] 1,723,104	[4] 410,169	[4] 1,592,051
Coke .... do	2,430,688	[5] 12,408,881	2,872,026	[5] 15,445,452
Copper .... pounds	87,970,000	9,148,880	90,396,000	10,214,748
Gems and precious stones	....	(6)	....	(6)
Gypsum (crude) .... short tons	643,180	834,856	746,982	1,017,126
Iron:				
Ore—				
Sold to furnaces .... long tons	11,238,605	37,026,665	13,751,970	40,474,951
Sold for paint .... do	872	(2)	....	....
Pig .... short tons	1,275,640	[5] 18,872,150	1,340,402	[5] 18,472,588
Lime .... do	45,180	324,765	41,814	308,926
Magnesium .... pounds	10,650,121	(2)	12,823,633	3,462,380
Magnesium salts (natural):				
Carbonate .... do	(2)	(2)	(2)	(2)
Chloride .... do	(2)	(2)	(2)	(2)
Sulfate .... do	(2)	(2)	(2)	(2)
Manganiferous ore .... long tons	....	....	18,617	(2)
Marl, calcareous .... short tons	(2)	(2)	(2)	(2)
Mineral waters .... gallons sold	(6)	(6)	(6)	(6)
Natural gas .... M cubic feet	10,726,000	7,411,000	12,648,000	8,339,000
Natural gasoline .... gallons	2,971,000	89,000	3,919,000	162,000
Ores (crude), etc.: Copper .... short tons	4,603,751	(7)	4,438,219	(7)
Peat .... do	6,190	28,600	5,326	32,750
Petroleum .... barrels	23,462,000	21,350,000	19,753,000	20,150,000
Salt .... short tons	2,408,872	6,726,912	2,863,035	7,479,905
Sand and gravel .... do	10,748,007	4,087,508	13,650,528	4,978,006
Sand-lime brick .... thousands of brick	[8] 21,475	[8] 197,659	[8] 14,564	[8] 170,678
Silver .... troy ounces	101,878	69,154	88,657	63,045
Stone .... short tons	11,138,280	5,890,728	13,527,170	6,891,433
Miscellaneous [9]	....	3,836,239	....	1,891,690
Total value, eliminating duplications	....	116,088,154	....	124,774,581

[1] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[2] Value included under "Miscellaneous."
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Figures obtained through cooperation with Bureau of the Census
[9] Includes minerals indicated by "2" above.

Mineral production of Minnesota, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement .... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...	....	[2] $1,013,688	....	[2] $988,116
Raw (sold by producers) .... short tons..	2,010	5,253	(1)	(1)
Coke .... do....	497,079	[3] 3,684,811	524,360	[3] 3,662,908
Flint lining for tube mills .... do....	(1)	(1)	(1)	(1)
Gems and precious stones	....	(4)	....	(4)
Iron:				
Ore .... long tons..	32,370,241	97,113,591	47,904,137	118,947,968
Pig .... short tons..	188,013	(1 3)	282,728	(1 3)
Lime .... do....	(1)	(1)	(1)	(1)
Manganiferous ore .... long tons..	651,963	(1)	1,046,374	2,894,388
Marl, calcareous .... short tons..	800	745	(1)	(1)
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Peat .... short tons..	(1)	(1)	1,984	19,980
Pebbles for grinding .... do....	(1)	(1)	(1)	(1)
Sand and gravel .... do....	8,501,211	1,942,430	8,729,205	1,924,716
Sand-lime brick .... thousands of brick..	[2] 18,428	[2] 182,443	(1 2)	(1 2)
Stone .... short tons..	1,405,740	2,339,774	1,119,230	1,987,822
Miscellaneous [5]	....	7,188,055	....	7,083,749
Total value, eliminating duplications	....	106,455,607	....	128,571,690

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass
[5] Includes minerals indicated by "1" above.

Mineral production of Mississippi, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories) ..	....	[1] $761,686	....	[1] $787,000
Raw (sold by producers) .... short tons..	(2)	(2)	(2)	(2)
Iron ore .... long tons..	....	....	50	38
Mineral waters .... gallons sold..	(3)	(3)	(3)	(3)
Natural gas .... M cubic feet..	14,527,000	3,300,000	6,365,000	1,637,000
Petroleum .... barrels..	107,000	94,000	4,400,000	3,750,000
Sand and gravel .... short tons..	2,336,842	810,933	2,319,073	724,777
Stone .... do....	(2)	(2)	[4] 210	[4] 410
Miscellaneous [5]	....	225,537	....	340,422
Total value, eliminating duplications	....	5,192,156	....	7,239,647

[1] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[2] Value included under "Miscellaneous"
[3] No canvass.
[4] Exclusive of limestone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "2" and "4" above

Mineral production of Missouri, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Barite do	171,642	$1,163,870	179,455	$1,216,069
Cement barrels	4,702,259	7,420,013	4,867,799	7,616,247
Chats short tons	524,100	59,900	1,470,849	238,266
Clay:				
Products (other than pottery and refractories)		[2] 2,759,036		[2] 2,064,000
Raw (sold by producers) short tons	384,665	1,172,029	498,150	1,400,932
Coal do	[3] 3,273,550	[3] 6,138,603	[4] 3,096,741	[4] 6,320,770
Coke do	(1 5)	(1 5)	(1 5)	(1 5)
Copper pounds			1,370,000	154,810
Iron ore—				
Sold to furnaces, etc. long tons	36,638	53,839	50,217	123,234
Sold for paint do	2,117	5,346	3,203	11,177
Lead short tons	156,281	14,690,414	172,052	17,205,200
Lime do	516,988	2,800,379	607,062	3,184,293
Mineral paints (zinc and lead pigments) do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	538,000	312,000	310,000	166,000
Ores (crude), etc.:				
Lead short tons	5,127,000	(7)	5,837,550	(7)
Zinc do	20,200	(7)	201,055	(7)
Zinc-lead do	503,600	(7)	418,795	(7)
Petroleum barrels	40,000	30,000	44,000	34,000
Pyrites long tons	32,496	68,369	29,325	74,088
Sand and gravel short tons	3,857,406	2,310,995	4,057,571	2,311,221
Sand and sandstone (ground) do	(1)	(1)	(1)	(1)
Sand-lime brick thousands of brick	(1 8)	(1 8)	(1 8)	(1 8)
Silver troy ounces	213,400	144,853	260,314	185,112
Stone short tons	[9] 3,958,470	[9] 4,589,986	6,085,790	6,176,867
Tripoli do	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates) do			13	(1)
Zinc do	15,096	1,569,984	12,703	1,600,578
Miscellaneous [10]		1,711,108		1,876,041
Total value, eliminating duplications		45,633,707		50,324,566

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses
[5] Value not included in total value for State.
[6] No canvass
[7] Not valued as ore, value of recoverable metal content included under the metals.
[8] Figures obtained through cooperation with Bureau of the Census.
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

Mineral production of Montana, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)............short tons..	....	....	69	$3,000
Arsenious oxide............do....	(1)	(1)	(1)	(1)
Asbestos............do....	(1)	(1)	(1)	(1)
Barite............do....	(1)	(1)	....	....
Bismuth............pounds..	(2)	(2)	(2)	(2)
Cement............barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)....	....	[3] $203,727	....	[3] 155,000
Raw (sold by producers)............short tons..	(1)	(1)	(1)	(1)
Coal:				
Bituminous............do....	[4] 2,803,749	[4] 4,092,157	[5] 2,818,936	[5] 4,075,528
Lignite............do....			48,264	86,000
Copper............pounds..	195,654,000	20,348,016	252,782,000	28,564,366
Gems and precious stones............	....	(6)	....	(6)
Gold............troy ounces..	264,173	9,246,055	272,602	9,541,070
Gypsum (crude)............short tons..	(1)	(1)	(1)	(1)
Lead............do....	16,555	1,556,170	23,036	2,303,600
Lime............do....	(1)	(1)	18,797	77,658
Manganese ore............long tons..	11,139	(1)	19,343	(1)
Manganiferous ore............do....	2,121	(1)	3,617	(1)
Mineral waters............gallons sold..	(6)	(6)	(6)	(6)
Natural gas............M cubic feet..	23,178,000	6,486,000	26,231,000	7,132,000
Natural gasoline............gallons..	2,161,000	154,000	2,603,000	162,000
Ores (crude), etc.:				
Copper............short tons..	2,253,270	(7)	3,287,803	(7)
Dry and siliceous (gold and silver)............do....	1,049,461	(7)	1,028,523	(7)
Lead............do....	23,096	(7)	29,454	(7)
Lead-copper............do....	....	....	71	(7)
Zinc............do....	146,705	(7)	174,181	(7)
Zinc-lead............do....	320,248	(7)	579,209	(7)
Petroleum............barrels..	5,960,000	5,860,000	6,728,000	6,660,000
Phosphate rock............long tons..	44,384	112,142	64,239	184,844
Platinum metals (crude)............troy ounces..	....	....	31	(1)
Pyrites............long tons..	(1)	(1)	(1)	(1)
Sand and gravel............short tons..	4,305,553	1,678,098	4,978,353	1,953,009
Silver............troy ounces..	9,087,571	6,168,533	12,361,050	8,790,080
Stone............short tons..	1,266,220	1,714,718	829,600	813,286
Tin (metallic equivalent)............pounds..	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates)..short tons..	23	(1)	50	(1)
Vermiculite............do....	(1)	(1)	(1)	(1)
Zinc............do....	34,799	3,619,096	52,587	6,625,962
Miscellaneous [8]............	....	2,105,090	....	2,360,470
Total value, eliminating duplications............	....	63,343,802	....	79,487,873

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

Mineral production of Nebraska, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	...	[2] $569,953	...	[2] $412,000
Raw (sold by producers) ... short tons	19,576	9,185	10,417	5,781
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Petroleum ... barrels	2,000	2,000	276,000	220,000
Pumice ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	2,494,142	878,366	3,051,706	1,072,935
Stone ... do	427,580	660,732	832,890	906,563
Miscellaneous [4]	...	2,270,055	...	2,074,867
Total value, eliminating duplications	...	4,390,291	...	4,692,146

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] No canvass.
[4] Includes minerals indicated by "1" above.

Mineral production of Nevada, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Andalusite ... short tons	(1)	(1)	(1)	(1)
Antimony ore (concentrates) ... do	137	(1)	361	$22,100
Barite ... do	(1)	(1)	(1)	(1)
Bismuth ... pounds	(2)	(2)	(2)	(2)
Boron minerals ... short tons	300	$4,500	...	...
Clay:				
Products (other than pottery and refractories)	...	(1 3)	...	(1 3)
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Copper ... pounds	133,194,000	13,852,176	156,908,000	17,730,604
Diatomite ... short tons	(1)	(1)	(1)	(1)
Dumortierite ... do	(1)	(1)	(1)	(1)
Fluorspar ... do	3,520	(1)	5,803	(1)
Fuller's earth ... do	(1)	(1)	(1)	(1)
Gems and precious stones	...	(4)	...	(4)
Gold ... troy ounces	361,518	12,653,130	383,933	13,437,655
Graphite, amorphous ... short tons	(1)	(1)	(1)	(1)
Gypsum (crude) ... do	205,762	484,621	250,632	618,050
Lead ... do	4,236	398,184	7,499	749,900
Lime ... do	(1)	(1)	(1)	(1)
Magnesite ... do	(1)	(1)	(1)	(1)
Magnesium oxide (hydrated) (brucite) ... do	(1)	(1)	(1)	(1)
Manganese ore ... long tons	...	...	210	(1)
Manganiferous ore ... do	...	...	4,613	(1)
Marl, calcareous ... short tons	(1)	(1)	(1)	(1)
Mercury ... flasks (76 pounds)	828	86,062	5,924	1,047,778
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Copper ... short tons	4,936,001	(5)	6,158,388	(5)
Dry and siliceous (gold and silver) ... do	1,907,051	(5)	2,044,000	(5)
Lead ... do	6,730	(5)	7,080	(5)
Lead-copper ... do	219	(5)	9	(5)
Zinc ... do	150	(5)	1.968	(5)
Zinc-lead ... do	44,848	(5)	126,814	(5)
Pumice ... do	(1)	(1)	...	...
Sand and gravel ... do	1,329,810	453,047	1,803.924	543,036
Silver ... troy ounces	4,316,029	2,929,668	5,175,928	3,680,660
Stone ... short tons	[6] 34,260	[6] 40,207	171,670	189,143
Sulfur ore ... long tons	43	343	41	403
Talc and pinite ... short tons	...	...	(1)	(1)
Tungsten ore (60-percent concentrates) ... do	2,091	(1)	1,796	(1)
Zinc ... do	6,228	647,712	11,833	1,490,958
Miscellaneous [7]	...	3,121,229	...	3,060,242
Total value, eliminating duplications	...	34,670,879	...	42,570,529

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of limestone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of New Hampshire, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		[1] $321,751		[1] $204,228
Feldspar (crude) long tons	34,414	161,968	38,589	149,031
Garnet, abrasive short tons	(2)	(2)		
Gems and precious stones		(3)		(3)
Mica:				
Scrap short tons	105	1,592	(2)	(2)
Sheet pounds	43,670	3,738	(2)	(2)
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Peat short tons	(2)	(2)	143	2,116
Sand and gravel do.	2,067,994	219,296	2,132,525	266,338
Scythestones do.	(2)	(2)	(2)	(2)
Stone do.	105,390	437,342	[4] 51,250	[4] 409,616
Miscellaneous [5]		41,652		34,008
Total value, eliminating duplications		1,187,339		1,065,337

[1] Figures obtained through cooperation with Bureau of the Census
[2] Value included under "Miscellaneous."
[3] No canvass
[4] Exclusive of basalt, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "2" and "4" above.

Mineral production of New Jersey, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay.				
Products (other than pottery and refractories)		[2] $6,726,041		[2] $6,489,000
Raw (sold by producers) short tons	96,629	522,684	95,186	529,914
Coke do.	1,003,197	(1 3)	1,016,481	(1 3)
Ferro-alloys do.	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore long tons	394,709	1,865,037	693,998	3,328,467
Lime short tons	22,636	148,605	28,854	206,326
Manganiferous residuum long tons	129,238	(1)	154,455	(1)
Marl, greensand short tons	6,466	318,550	6,697	389,888
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Ore (zinc) short tons	606,504	(5)	556,031	(5)
Peat do.	11,781	62,372	10,056	51,565
Sand and gravel do.	4,319,297	3,361,955	4,918,350	3,846,902
Sand and sandstone (ground) do.	88,946	577,811	(1)	(1)
Sand-lime brick thousands of brick	(1 6)	(1 6)	(1 6)	(1 6)
Silica (quartz) short tons			(1)	(1)
Stone do.	2,806,020	3,036,516	2,705,170	2,888,339
Talc do.			(1)	(1)
Zinc [7] do.	88,716	11,507,318	91,406	13,121,911
Miscellaneous [8]		8,937,506		9,814,738
Total value, eliminating duplications		30,441,758		33,653,732

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] Value not included in total value for State.
[4] No canvass
[5] Not valued as ore; value of recoverable metal content included under the metal.
[6] Figures obtained through cooperation with Bureau of the Census
[7] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[8] Includes minerals indicated by "1" above.

Mineral production of New Mexico, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Arsenious oxide .... short tons	(1)	(1)	(1)	(1)
Bismuth .... pounds			(1)	(1)
Calcite (Iceland spar) .... do	(2)	(2)		
Clay				
Products (other than pottery and refractories)		[3] $162, 003		[3] $98, 000
Raw (sold by producers) .... short tons	7, 767	19, 686	11, 378	18, 322
Coal .... do	[4] 1, 230, 060	[4] 3, 503, 032	[5] 1, 110, 615	[5] 3, 304, 046
Copper .... pounds	92, 284, 000	9, 597, 536	139, 696, 000	15, 785, 648
Diatomite .... short tons			(2)	(2)
Fluorspar .... do	(2)	(2)	(2)	(2)
Fuller's earth .... do			(2)	(2)
Gems and precious stones		(6)		(6)
Gold .... troy ounces	36, 979	1, 294, 265	35, 943	1, 258, 005
Lead .... short tons	5, 392	506, 848	3, 822	382, 200
Lime .... do	(2)	(2)	(2)	(2)
Manganese ore .... long tons	339	(2)	45	(2)
Manganiferous ore .... do	31, 999	(2)	36, 835	(2)
Mica:				
Scrap .... short tons	(2)	(2)	(2)	(2)
Sheet .... pounds	(2)	(2)	(2)	(2)
Mineral waters .... gallons sold	(6)	(6)	(6)	(6)
Molybdenum .... pounds	1, 269, 182	(2)	1, 897, 063	(2)
Natural gas .... M cubic feet	60, 284, 000	8, 778, 000	63, 990, 000	10, 317, [illegible]00
Natural gasoline .... gallons	54, 707, 000	1, 696, 000	55, 713, 000	879, 000
Ores (crude), etc.:				
Copper .... short tons	4, 517, 429	(7)	6, 606, 471	(7)
Dry and siliceous (gold and silver) .... do	111, 202	(7)	127, 014	(7)
Lead .... do	1, 431	(7)	1, 901	(7)
Lead-copper .... do	1, 102	(7)		
Zinc .... do	217, 517	(7)	123, 126	(7)
Zinc-lead .... do	128, 694	(7)	231, 391	(7)
Petroleum .... barrels	37, 637, 000	30, 850, 000	39, 129, 000	32, 500, 000
Potassium salts .... short tons	(2)	(2)	(2)	(2)
Pumice .... do	(2)	(2)	(2)	(2)
Salt .... do	(2)	(2)	13, 915	41, 573
Sand and gravel .... do	[8] 1, 832, 733	[8] 1, 131, 804	[8] 2, 364, 939	[8] 1, 141, 380
Silver .... troy ounces	1, 400, 878	950, 899	1, 407, 839	1, 001, 130
Stone .... short tons	[9] 287, 190	[9] 164, 924	362, 020	223, 680
Tantalum ore .... pounds	(2)	(2)		
Tin (metallic equivalent) .... do	(2)	(2)	(2)	(2)
Tungsten ore (60-percent concentrates) .... do			98	(2)
Zinc .... short tons	29, 356	3, 053, 024	30, 313	3, 819, 438
Miscellaneous [10]		8, 279, 776		10, 200, 301
Total value, eliminating duplications		69, 987, 797		80, 969, 723

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses
[5] According to Bituminous Coal Division, value includes selling expenses.
[6] No canvass
[7] Not valued as ore, value of recoverable metal content included under the metals.
[8] "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
[9] Exclusive of basalt, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "2", "8", and "9" above.

Mineral production of New York, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	179,177,116	[2] $32,700,000
Cement ... barrels	[3] 6,853,796	[3] $9,866,102	[3] 8,251,038	[3] 11,687,089
Clay:				
Products (other than pottery and refractories)		[4] 6,883,109		[4] 5,820,000
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coke ... do	4,468,437	[2] 25,526,646	5,080,403	[2] 29,519,871
Diatomite ... do	(1)	(1)	(1)	(1)
Emery ... do	765	6,828	1,046	9,349
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Ferro-alloys ... short tons	183,465	[2] 18,388,766	259,303	[2] 30,719,756
Garnet, abrasive ... do	(1)	(1)	(1)	(1)
Gems and precious stones		(5)		(5)
Graphite:				
Artificial ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Crystalline ... do	(1)	(1)		
Gypsum (crude) ... short tons	709,495	971,229	798,229	1,037,181
Iron:				
Ore—				
Sold to furnaces ... long tons	(1)	(1)	(1)	(1)
Sold for paint ... do	(1)	(1)	(1)	(1)
Pig ... short tons	2,475,450	[2] 45,275,716	3,206,162	[2] 54,150,107
Lead ... do	(1)	(1)	1,973	197,300
Lime ... do	42,225	314,457	54,364	408,645
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds	(1)	(1)	(1)	(1)
Millstones		2,584		(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	29,222,000	15,201,000	12,187,000	8,246,000
Natural gasoline ... gallons	34,000	1,000	17,000	1,000
Ores (crude), etc.				
Zinc ... short tons	115,000	(6)	116,171	(6)
Zinc-lead ... do	305,000	(6)	316,048	(6)
Peat ... do	18,306	116,875	19,352	148,433
Petroleum ... barrels	5,098,000	10,650,000	4,999,000	11,600,000
Pyrites ... long tons	71,176	(1)	64,498	233,816
Salt ... short tons	2,041,492	5,855,422	2,117,671	6,523,775
Sand and gravel ... do	[7] 12,608,128	[7] 7,050,104	[7] 13,225,133	[7] 7,639,668
Sand-lime brick ... thousands of brick	(1 8)	(1 8)	(1 8)	(1 8)
Silica (quartz) ... short tons	(1)	(1)	(1)	(1)
Silver ... troy ounces	37,250	25,285	35,720	25,401
Slate		405,837		479,053
Stone ... short tons	10,703,690	10,111,032	9,782,120	10,398,401
Talc ... do	99,880	1,252,525	113,611	1,402,524
Zinc ... do	36,014	3,745,456	35,686	4,496,436
Miscellaneous [9]		35,810,535		6,080,854
Total value, eliminating duplications		78,409,560		76,119,505

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[8] Figures obtained through cooperation with Bureau of the Census.
[9] Includes minerals indicated by "1", "3", and "7" above.

Mineral production of North Carolina, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	58,882,397	[2] $10,746,000
Asbestos ... short tons	(1)	(1)	(1)	(1)
Bromine ... pounds	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	-----	[3] $4,595,857	-----	[3] 4,629,000
Raw (sold by producers) ... short tons	11,365	166,010	14,620	202,678
Copper ... pounds	(1)	(1)	(1)	(1)
Feldspar (crude) ... long tons	76,738	397,631	79,312	426,784
Garnet, abrasive ... short tons	(1)	(1)	(1)	(1)
Gems and precious stones	-----	(4)	-----	(4)
Gold ... troy ounces	495	17,325	1,943	68,005
Kyanite ... short tons	(1)	(1)	(1)	(1)
Lime ... do	(1)	(1)	(1)	(1)
Lithium minerals ... do	-----	-----	(1)	(1)
Manganese ore ... long tons	43	796	-----	-----
Manganiferous ore ... do	51	632	190	(1)
Mica:				
Scrap ... short tons	13,913	184,377	11,505	173,327
Sheet ... pounds	401,170	69,344	1,002,646	218,154
Millstones	-----	(1)	-----	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Olivine ... short tons	3,000	15,000	2,500	15,000
Ores (crude):				
Copper ... do	15,310	(5)	20,311	(5)
Dry and siliceous (gold and silver) ... do	1,430	(5)	7,927	(5)
Pebbles for grinding ... do	-----	-----	(1)	(1)
Sand and gravel ... do	2,383,772	1,001,369	3,213,855	1,439,457
Sand and sandstone (ground) ... do	-----	-----	(1)	(1)
Silica (quartz) ... do	(1)	(1)	(1)	(1)
Silver ... troy ounces	3,961	2,689	6,480	4,608
Stone ... short tons	[6] 6,037,000	[6] 6,979,426	3,031,300	4,850,277
Talc and pyrophyllite ... do	36,772	283,789	39,206	298,382
Vermiculite ... do	1,400	14,400	1,040	8,070
Miscellaneous [7]	-----	13,029,075	-----	8,778,990
Total value, eliminating duplications	-----	18,533,720	-----	21,112,732

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of North Dakota, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)	-----	(1 2)	-----	(1 2)
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	2,131,252	$2,425,000	2,218,454	$2,587,000
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	76,000	29,000	-----	-----
Sand and gravel ... short tons	1,464,738	128,279	3,202,167	298,646
Stone ... do	(1)	(1)	(1)	(1)
Miscellaneous [4]	-----	107,348	-----	101,705
Total value, eliminating duplications	-----	2,689,627	-----	2,987,351

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Includes minerals indicated by "1" above.

Mineral production of Ohio, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Bromine ... pounds	(1)	(1)	(1)	(1)
Calcium chloride ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	[2] 6,140,125	[2] $8,233,817	[2] 6,841,129	[2] $9,202,414
Clay:				
Products (other than pottery and refractories)		[3] 26,539,916		[3] 24,711,000
Raw (sold by producers) ... short tons	469,152	912,780	514,257	1,058,016
Coal ... do	[4] 20,289,553	[4] 33,127,116	[5] 22,771,552	[5] 39,039,016
Coke ... do	6,135,949	[6] 28,592,024	7,897,929	[6] 38,568,313
Ferro-alloys ... do	160,921	[6] 6,084,252	189,499	[6] 8,793,122
Grindstones ... do	7,524	246,119	8,539	278,274
Gypsum (crude) ... do	(1)	(1)	(1)	(1)
Iron, pig ... do	8,119,073	[6] 147,154,864	10,275,696	[6] 193,283,920
Lime ... do	1,106,250	8,907,195	1,284,877	10,180,785
Marl, calcareous ... do	(1)	(1)	(1)	(1)
Mineral paints (zinc and lead pigments) ... do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Natural gas ... M cubic feet	36,469,000	18,818,000	40,639,000	20,850,000
Natural gasoline ... gallons	7,445,000	351,000	8,062,000	333,000
Peat ... short tons	1,623	14,400	2,531	24,087
Petroleum ... barrels	3,156,000	3,600,000	3,159,000	4,100,000
Rubbing stones, scythestones, and whetstones short tons	(1)	(1)	(1)	(1)
Salt ... do	1,794,788	2,647,355	2,080,133	2,781,599
Sand and gravel ... do	8,660,485	6,595,483	9,558,904	7,182,453
Sand and sandstone (ground) ... do	36,950	223,965	(1)	(1)
Silica (quartz) ... do	(1)	(1)		
Stone ... do	[8] 11,133,560	[8] 10,140,272	[8] 11,915,520	[8] 10,234,221
Strontium minerals ... do			(1)	(1)
Sulfuric acid [9] ... do	(1 6)	(1 6)	(1 6)	(1 6)
Miscellaneous [10]		2,217,812		2,865,443
Total value, eliminating duplications		120,681,969		130,055,129

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[9] From zinc-roasting operation.
[10] Includes minerals indicated by "1", "2", and "8" above.

Mineral production of Oklahoma, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Chats short tons	1,663,100	(1)	2,152,877	$308,726
Clay:				
Products (other than pottery and refractories)		[2] $720,587		[2] 532,000
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Coal do	[3] 1,187,562	[3] 2,503,456	[4] 1,645,981	[4] 4,021,780
Gypsum (crude) do	161,748	207,503	176,166	227,534
Iron ore long tons			(1)	(1)
Lead short tons	27,720	2,605,680	21,240	2,124,000
Lime do	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Natural gas M cubic feet	250,875,000	28,163,000	257,626,000	31,603,000
Natural gasoline gallons	436,123,000	15,502,000	399,369,000	8,926,000
Ores (crude), etc.:				
Zinc short tons	3,465,900	(6)	5,813,405	(6)
Zinc-lead do	5,337,000	(6)	5,436,995	(6)
Petroleum barrels	159,913,000	166,300,000	156,164,000	162,500,000
Pumice short tons	(1)	(1)	(1)	(1)
Salt do	(1)	(1)	(1)	(1)
Sand and gravel do	859,060	400,478	1,030,435	284,010
Stone do	1,992,660	1,820,409	1,311,640	1,217,525
Sulfuric acid [7] do	(1 8)	(1 8)	(1 8)	(1 8)
Tripoli do	(1)	(1)	(1)	(1)
Zinc do	140,379	14,599,416	162,935	20,529,810
Miscellaneous [9]		3,945,534		3,669,930
Total value, eliminating duplications		236,194,064		235,494,159

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census, producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Not valued as ore, value of recoverable metal content included under the metals.
[7] From zinc smelting.
[8] Value not included in total value for State.
[9] Includes minerals indicated by "1" above.

Mineral production of Oregon, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	(2)	(2)	(2)	(2)
Chromite ... long tons	100	(2)	(2)	(2)
Clay				
Products (other than pottery and refractories)		[3] $410,963		[3] $397,000
Raw (sold by producers) ... short tons	(2)	(2)	(2)	(2)
Coal ... do	(2 4)	(2 4)	(2 5)	(2 5)
Copper ... pounds	96,000	9,984	176,000	19,888
Diatomite ... short tons	(2)	(2)	(2)	(2)
Gems and precious stones		(6)		(6)
Gold ... troy ounces	93,372	3,268,020	113,402	3,969,070
Lead ... short tons	15	1,410	35	3,500
Lime ... do			(2)	(2)
Mercury ... flasks (76 pounds)	4,592	477,293	9,043	1,599,436
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Ores (crude), etc.:				
Copper ... short tons			146	(7)
Dry and siliceous (gold and silver) ... do	69,025	(7)	105,318	(7)
Lead ... do			5	(7)
Platinum metals (crude) ... troy ounces	20	260	69	(2)
Pumice ... short tons	(2)	(2)	(2)	(2)
Sand and gravel ... do	3,144,917	1,233,320	[8] 1,622,921	[8] 859,943
Silica (quartz) ... do	910	5,600	1,600	10,000
Silver ... troy ounces	105,388	71,536	219,112	155,813
Stone ... short tons	2,225,610	1,682,175	[9] 2,757,820	[9] 2,234,928
Miscellaneous [10]		1,476,486		1,980,692
Total value, eliminating duplications		8,637,047		11,229,670

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "2," "8," and "9" above.

Mineral production of Pennsylvania, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asbestos……short tons			(1)	(1)
Cement……barrels	[2] 24,870,343	[2] $34,332,649	[2] 27,499,786	[2] $38,350,998
Clay:				
Products (other than pottery and refractories)		[3] 11,351,849		[3] 11,031,000
Raw (sold by producers)……short tons	667,140	1,675,019	899,173	2,189,509
Coal:				
Anthracite……do	51,487,377	187,175,000	51,484,640	205,490,000
Bituminous……do	[4] 92,584,113	[4] 187,609,657	[5] 116,602,999	[5] 237,333,374
Cobalt oxide……pounds			(1)	(1)
Coke……short tons	12,120,225	[6] 49,015,558	17,412,024	[6] 69,599,076
Copper [7]……pounds	(1)	(1)	(1)	(1)
Feldspar (crude)……long tons	(1)	(1)	(1)	(1)
Ferro-alloys……short tons	322,647	[6] 29,609,712	512,174	[6] 56,983,213
Gems and precious stones		(8)		(8)
Gold [7]……troy ounces	1,815	63,525	1,840	64,400
Iron:				
Ore—				
Sold to furnaces……long tons	(1)	(1)	(1)	(1)
Sold for paint……do	463	(1)	(1)	(1)
Pig……short tons	10,057,207	[6] 186,302,533	14,571,517	[6] 282,666,561
Lime……do	691,460	4,744,197	833,038	5,622,725
Mineral paints (zinc and lead pigments)……do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters……gallons sold	(8)	(8)	(8)	(8)
Natural gas……M cubic feet	93,882,000	35,268,000	90,725,000	41,733,000
Natural gasoline……gallons	11,756,000	499,000	15,371,000	594,000
Peat……short tons	(1)	(1)	8,310	23,540
Petroleum……barrels	17,382,000	36,200,000	17,353,000	39,700,000
Pyrites……long tons	(1)	(1)	(1)	(1)
Sand and gravel……short tons	6,779,592	6,752,222	8,431,656	8,000,225
Sand and sandstone (ground)……do	(1)	(1)	(1)	(1)
Sand-lime brick……thousands of brick	(1 9)	(1 9)	(1 9)	(1 9)
Silica (quartz)……short tons			(1)	(1)
Silver [7]……troy ounces	13,558	9,203	13,064	9,290
Slate		3,056,853		2,609,801
Soapstone……short tons	(1)	(1)	(1)	(1)
Stone……do	[10] 15,743,790	[10] 16,906,854	[10] 19,277,690	[10] 19,855,478
Sulfuric acid (60° Baumé) [11]……do	254,758	[6] 2,295,370	299,751	[6] 2,739,724
Tripoli (rottenstone)……do	(1)	(1)	(1)	(1)
Miscellaneous [12]		14,660,980		15,290,396
Total value, eliminating duplications		531,007,890		618,347,805

1 Value included under "Miscellaneous."
2 Exclusive of natural cement, value for which is included under "Miscellaneous."
3 Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
4 According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
5 According to Bituminous Coal Division; value includes selling expenses.
6 Value not included in total value for State.
7 Copper, gold, and silver were recovered from magnetite-pyrite-chalcopyrite ore, which is included as iron ore produced. Bureau of Mines not at liberty to publish figures.
8 No canvass.
9 Figures obtained through cooperation with Bureau of the Census.
10 Exclusive of dimension basalt, value for which is included under "Miscellaneous."
11 From zinc smelting.
12 Includes minerals indicated by "1," "2," and "10" above.

Mineral production of Rhode Island, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Coke short tons	(1 3)	(1 3)	(1 3)	(1 3)
Lime do	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Sand and gravel short tons	383,557	$265,631	515,129	$333,612
Stone do	320,780	558,944	[5] 201,380	[5] 511,620
Miscellaneous [6]		1,690,297		1,960,840
Total value, eliminating duplications		980,916		994,997

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass
[5] Exclusive of dimension basalt, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Carolina, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)		
Barite do	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $1,573,470		[2] $1,688,000
Raw (sold by producers) short tons	159,164	1,303,163	152,529	1,306,438
Copper pounds			800	90
Gold troy ounces	13,833	484,155	13,076	457,660
Mica:				
Scrap short tons			(1)	(1)
Sheet pounds			(1)	(1)
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Ore (dry and siliceous) (gold and silver) short tons	114,514	(4)	126,607	(4)
Sand and gravel do	546,428	313,758	515,247	260,857
Silver troy ounces	5,480	3,720	8,047	5,722
Stone short tons	[5] 1,339,030	[5] 1,732,795	[5] 1,233,610	[5] 1,570,689
Miscellaneous [6]		11,918		16,141
Total value, eliminating duplications		5,422,979		5,305,597

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Dakota, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Beryllium ore (beryl) ... short tons	84	$2,390	74	$2,064
Cement ... barrels	([1])	([1])	([1])	([1])
Clay:				
Products (other than pottery and refractories)	...	([1] [2])	...	([1] [2])
Raw (sold by producers) ... short tons	31,528	217,622	40,481	274,714
Coal ... do	49,495	69,000	66,085	88,000
Copper ... pounds	...	...	12,000	1,356
Feldspar (crude) ... long tons	48,328	133,893	54,692	157,323
Gems and precious stones	...	([3])	...	([3])
Gold ... troy ounces	618,536	21,648,760	586,662	20,533,170
Gypsum (crude) ... short tons	([1])	([1])	([1])	([1])
Iron ore sold for paint ... long tons	300	([1])	640	([1])
Lead ... short tons	...	...	7	700
Lime ... do	([1])	([1])	([1])	([1])
Lithium minerals ... do	1,740	34,300	([1])	([1])
Mica:				
Scrap ... do	([1])	([1])	2,240	32,074
Sheet ... pounds	([1])	([1])	107,062	12,509
Mineral waters ... gallons sold	([3])	([3])	([3])	([3])
Natural gas ... M cubic feet	10,000	3,000	9,000	3,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	1,632,778	([4])	1,667,289	([4])
Lead ... do	...	...	81	([4])
Sand and gravel ... do	2,539,417	722,046	2,910,331	524,842
Sand-lime brick ... thousands of brick	([1] [2])	([1] [2])	([1] [2])	([1] [2])
Silver ... troy ounces	167,584	113,754	175,514	124,810
Stone ... short tons	408,730	998,444	255,600	878,866
Tantalum ore ... pounds	([1])	([1])	...	...
Tin (metallic equivalent) ... short tons	([5])	608	2	1,710
Miscellaneous [6]	...	869,804	...	893,687
Total value, eliminating duplications	...	24,813,621	...	23,528,825

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] 1,210 pounds.
[6] Includes minerals indicated by "1" above.

Mineral production of Tennessee, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Aluminum....pounds..	(1 2)	(1 2)	164,512,530	2 $30,023,000
Barite....short tons..	57,140	$372,348	70,767	503,204
Cement....barrels..	3,677,116	5,613,477	3,766,807	5,655,635
Clay:				
Products (other than pottery and refractories)...		3 2,107,917		3 1,869,000
Raw (sold by producers)....short tons..	61,867	425,008	89,582	491,271
Coal....do....	4 5,185,481	4 10,100,341	5 6,008,456	5 12,024,742
Coke....do....	79,448	2 527,535	99,705	2 618,746
Copper....pounds..	(1)	(1)	(1)	(1)
Ferro-alloys....short tons..	22,494	2 1,442,967	38,900	2 3,041,405
Fuller's earth....do....	(1)	(1)	(1)	(1)
Gold....troy ounces..	163	5,705	173	6,055
Iron:				
Ore—				
Sold to furnaces....long tons..	(1)	(1)	(1)	(1)
Sold for paint....do....	781	3,044	169	(1)
Pig....short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Sinter from copper sulfide ore....long tons..	(1)	(1)	(1)	(1)
Lead....short tons..	(1)	(1)	573	57,300
Lime....do....	163,006	893,161	192,133	1,050,199
Manganese ore....long tons..	7,835	128,176	7,418	120,736
Manganiferous ore....do....	294	2,030	2,327	(1)
Mineral waters....gallons sold..	(6)	(6)	(6)	(6)
Natural gas....M cubic feet..	8,000	3,000	9,000	3,000
Ores (crude), etc.:				
Copper....short tons..	513,400	(7)	705,574	(7)
Dry and siliceous (gold and silver)....do....	20	(7)		
Lead....do....			8,709	(7)
Zinc....do....	1,065,900	(7)	1,206,786	(7)
Zinc-lead....do....	18,000	(7)	549	(7)
Petroleum....barrels..	50,000	55,000	24,000	23,000
Phosphate rock....long tons..	(1)	(1)	(1)	(1)
Pyrites....do....	(1)	(1)	(1)	(1)
Sand and gravel....short tons..	2,689,844	1,967,356	3,104,382	2,255,287
Silica (quartz)....do....	(1)	(1)	(1)	(1)
Silver....troy ounces..	31,994	21,717	38,610	27,456
Slate....		(1)		
Stone....short tons..	8 5,626,210	8 8,312,977	5,604,170	6,674,710
Sulfuric acid 9....do....	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli....do....	(1)	(1)		
Zinc....do....	(1)	(1)	34,796	4,384,296
Miscellaneous 10....		37,574,261		8,832,008
Total value, eliminating duplications....		39,818,234		42,683,407

1 Value included under "Miscellaneous."
2 Value not included in total value for State.
3 Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
4 According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
5 According to Bituminous Coal Division; value includes selling expenses.
6 No canvass.
7 Not valued as ore; value of recoverable metal content included under the metals.
8 Exclusive of dimension limestone, value for which is included under "Miscellaneous."
9 From copper smelting.
10 Includes minerals indicated by "1" and "6" above.

Mineral production of Texas, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Asphalt (native) .... short tons	138,911	$333,818	158,220	$306,120
Barite .... do			100	450
Cement .... barrels	7,207,001	12,152,780	7,383,600	12,198,800
Clay:				
Products (other than pottery and refractories)		[1] 3,696,905		[1] 3,173,000
Raw (sold by producers) .... short tons	43,813	288,404	92,719	407,873
Coal:				
Bituminous .... do	(2 3)	(2 3)	[4] 14,137	[4] 48,278
Lignite .... do	814,022	875,000	606,418	637,000
Copper .... pounds	68,000	7,072	60,000	6,780
Fuller's earth .... short tons	38,338	359,058	34,039	277,229
Gems and precious stones		(5)		(5)
Gold .... troy ounces	324	11,340	312	10,920
Gypsum (crude) .... short tons	283,912	266,265	328,261	368,882
Helium .... cubic feet	[6] 6,281,800	[6] 75,262	[6] 9,450,855	[6] 85,061
Iron ore .... long tons	(2)	(2)	(2)	(2)
Lead .... short tons	227	21,338	205	20,500
Lime .... do	62,048	524,748	64,274	543,130
Magnesite .... do			(2)	(2)
Magnesium sulfate (natural) .... pounds			(2)	(2)
Mercury .... flasks (76 pounds)	(2)	(2)	(2)	(2)
Mineral waters .... gallons sold	(5)	(5)	(5)	(5)
Natural gas .... M cubic feet	979,427,000	141,535,000	1,063,538,000	151,580,000
Natural gasoline .... gallons	770,047,000	25,807,000	932,040,000	20,322,000
Ores (crude), etc.:				
Copper .... short tons	657	(7)	3	(7)
Dry and siliceous (gold and silver) .... do	141,132	(7)	146,811	(7)
Lead .... do	6	(7)	122	(7)
Petroleum .... barrels	483,528,000	478,330,000	493,209,000	494,000,000
Salt (sodium chloride) .... short tons	352,008	604,633	402,165	792,214
Sand and gravel .... do	7,622,309	3,670,423	6,930,975	3,446,085
Silver .... troy ounces	1,341,945	910,896	1,326,150	943,040
Sodium sulfate (natural) .... short tons	(2)	(2)	(2)	(2)
Stone .... do	3,771,750	3,320,508	2,737,690	2,581,358
Strontium minerals .... do	(8)	(2)	(8)	(2)
Sulfur .... long tons	1,784,952	28,498,473	2,008,968	32,143,480
Sulfur ore .... do			150	1,800
Tripoli .... short tons	(2)	(2)	(2)	(2)
Vermiculite .... do			(2)	(2)
Miscellaneous [9]		683,112		1,111,009
Total value, eliminating duplications		701,972,035		725,005,009

[1] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[2] Value included under "Miscellaneous."
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Figures cover fiscal year ended June 30 of year stated.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Figures not available.
[9] Includes minerals indicated by "2" above.

Mineral production of Utah, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Arsenious oxide.....short tons..	(1)	(1)	(1)	(1)
Asphalt (native).....do.....	37,364	$1,059,034	32,000	$776,171
Bismuth.....pounds..	(2)	(2)	(2)	(2)
Bitumen, natural sulfonated.....short tons..	(1)	(1)	(1)	(1)
Cement.....barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...	.....	[3] 668,717	.....	[3] 630,523
Raw (sold by producers).....short tons..	29,468	111,414	27,506	98,153
Coal.....do....	[4] 3,284,904	[4] 7,019,584	[5] 3,575,586	[5] 7,871,939
Coke.....do....	197,526	(1 6)	226,347	(1 6)
Copper.....pounds..	343,780,000	35,753,120	463,728,000	52,401,264
Fluorspar.....short tons..	385	(1)	142	(1)
Gems and precious stones.....	.....	(7)	.....	(7)
Gold.....troy ounces..	277,751	9,721,285	355,494	12,442,290
Gypsum (crude).....short tons..	58,146	65,269	45,421	60,055
Iron:				
Ore.....long tons..	262,087	(1)	326,500	(1)
Pig.....short tons..	(1 6)	(1 6)	(1 6)	(1 6)
Lead.....do....	67,634	6,357,596	75,688	7,568,800
Lime.....do....	38,437	268,557	49,413	306,357
Manganese ore.....long tons..	50	(1)	27	(1)
Manganiferous ore.....do....	262	1,550	2,102	13,134
Mercury.....flasks (76 pounds)..	.....	.....	53	9,374
Molybdenum.....pounds..	4,957,484	(1)	4,285,688	(1)
Natural gas.....M cubic feet..	4,854,000	1,033,000	5,124,000	1,063,000
Natural gasoline.....gallons..	500,000	26,000	722,000	28,000
Ores (crude), etc.:				
Copper.....short tons..	19,602,472	(8)	26,301,745	(8)
Dry and siliceous (gold and silver).....do....	838,897	(8)	795,123	(8)
Lead.....do....	77,072	(8)	65,072	(8)
Lead-copper.....do....	4,951	(8)	8,510	(8)
Zinc.....do....	.....	.....	26	(8)
Zinc-lead.....do.... } Zinc-lead-copper.....do....	570,705	(8)	768,870	(8)
Petroleum.....barrels..	4,000	4,000	3,000	3,000
Potassium salts.....short tons..	(1)	(1)	(1)	(1)
Salt (sodium chloride).....do....	68,100	202,244	71,472	191,263
Sand and gravel.....do....	2,218,678	1,100,013	1,899,563	582,708
Silver.....troy ounces..	10,758,657	7,302,846	12,172,299	8,655,857
Sodium sulfate (natural).....short tons..	(1)	(1)	(1)	(1)
Stone.....do....	[9] 700,610	[9] 444,856	1,024,660	693,127
Sulfur.....long tons..	(1)	(1)	(1)	(1)
Sulfuric acid [10].....short tons..	(1 6)	(1 6)	(1 6)	(1 6)
Tungsten ore (60-percent concentrates).....do....	3	(1)	14	(1)
Uranium and vanadium ores.....do....	2,237	(1)	3,600	(1)
Zinc.....do....	34,526	3,590,704	43,788	5,517,288
Miscellaneous [11].....	.....	9,355,393	.....	10,431,709
Total value, eliminating duplications.....	.....	80,127,521	.....	104,392,989

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of granite, value for which is included under "Miscellaneous."
[10] From copper smelting.
[11] Includes minerals indicated by "1" and "9" above.

Mineral production of Vermont, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Asbestos short tons	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Garnet, abrasive do	(1)	(1)	(1)	(1)
Lime do	63,316	$452,045	61,026	$430,178
Magnesite do	(1)	(1)		
Mica, scrap do	(1)	(1)	290	2,964
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Sand and gravel short tons	529,248	238,262	[4] 873,325	[4] 217,661
Slate		1,948,315		1,555,230
Stone short tons	232,770	3,412,005	[5] 135,680	[5] 3,681,752
Talc do	39,393	378,492	38,516	423,368
Miscellaneous [6]		543,145		668,619
Total value, eliminating duplications		6,972,234		6,979,772

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
[5] Exclusive of crushed sandstone. value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1", "4", and "5" above.

Mineral production of Virginia, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Aplite ... short tons	(1)	(1)	(1)	(1)
Asbestos ... do	(1)	(1)		
Barite ... do	(1)	(1)	(1)	(1)
Bauxite ... long tons			(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $2,818,947		[2] $2,602,000
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	[3] 13,530,974	[3] 24,993,885	[4] 15,348,075	[4] 29,965,943
Coke ... do	165,317	[5] 783,512	198,379	[5] 943,753
Feldspar (crude) ... long tons	18,544	100,299	21,705	116,531
Ferro-alloys ... short tons	(1 5)	(1 5)	(1 5)	(1 5)
Gold ... troy ounces	364	12,740	458	16,030
Gypsum (crude) ... short tons	(1)	(1)	(1)	(1)
Iron:				
Ore ... long tons	(1)	(1)	(1)	(1)
Pig ... short tons	(1 5)	(1 5)	(1 5)	(1 5)
Kyanite ... do	(1)	(1)	(1)	(1)
Lead ... do	(1)	(1)	2,285	228,500
Lime ... do	166,542	990,796	178,036	1,044,229
Manganese ore ... long tons	1,661	31,795	2,216	41,286
Manganiferous ore ... do	4,584	27,004	4,559	30,069
Marl, calcareous ... short tons	8,869	9,311	8,176	7,392
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds	(1)	(1)	(1)	(1)
Millstones		(1)		(1)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	60,000	48,000	80,000	81,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	3,350	(7)	2,480	(7)
Zinc-lead ... do	650,231	(7)	599,759	(7)
Phosphate rock ... long tons	(1)	(1)	(1)	(1)
Pyrites ... do	(1)	(1)	(1)	(1)
Salt ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	2,639,790	1,425,708	2,671,412	1,778,576
Sand and sandstone (ground) ... do	(1)	(1)	(1)	(1)
Silica (quartz) ... do	(1)	(1)	(1)	(1)
Silver ... troy ounces	1,780	1,208	271	193
Slate		(1)		(1)
Stone [8] ... short tons	5,813,630	5,879,447	6,800,640	6,959,136
Talc and ground soapstone [8] ... do	(1)	(1)	(1)	(1)
Titanium minerals:				
Ilmenite ... do	(1)	(1)	(1)	(1)
Rutile ... do	(1)	(1)	(1)	(1)
Zinc ... do	(1)	(1)	16,927	2,132,802
Miscellaneous [9]		11,613,097		10,966,418
Total value, eliminating duplications		43,9[illegible]2,881		50,003,672

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Soapstone used as dimension stone included in figures for stone.
[9] Includes minerals indicated by "1" above.

Mineral production of Washington, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Aluminum..........pounds..	....	....	9,987,957	[1] $1,823,000
Arsenious oxide..........short tons..	(2)	(2)	(3)	(2)
Cement..........barrels..	(3)	(3)	(3)	(3)
Clay:				
Products (other than pottery and refractories)...	....	[4] $1,030,025	....	[4] 1,241,000
Raw (sold by producers)..........short tons..	28,637	53,634	35,915	47,353
Coal..........do....	[5] 1,690,442	[5] 5,261,081	[6] 1,650,352	[6] 5,221,717
Coke..........do....	....	....	(1 3)	(1 3)
Copper..........pounds..	17,996,000	1,871,584	19,224,000	2,172,312
Diatomite..........short tons..	1,707	24,814	(3)	(3)
Gems and precious stones..........	....	(7)	....	(7)
Gold..........troy ounces..	90,420	3,164,700	82,136	2,874,760
Iron ore..........long tons..	10,747	44,188	5,582	(3)
Lead..........short tons..	3,718	349,492	2,555	255,500
Lime..........do....	47,485	484,667	53,428	582,416
Magnesite..........do....	(3)	(3)	(3)	(3)
Magnesium sulfate (natural)..........pounds..	(3)	(3)	(3)	(3)
Manganese ore..........long tons..	10	(3)	....	....
Mercury..........flasks (76 pounds)..	....	....	(3)	(3)
Mineral waters..........gallons sold..	(7)	(7)	(7)	(7)
Molybdenum..........pounds..	....	....	4,624	(3)
Natural gas..........M cubic feet..	63,000	59,000	36,000	37,000
Ores (crude), etc.:				
Copper..........short tons..	597,957	(8)	689,325	(8)
Dry and siliceous (gold and silver)..........do....	266,857	(8)	204,146	(8)
Lead..........do....	400	(8)	100	(8)
Zinc-lead..........do....	259,350	(8)	273,227	(8)
Peat..........do....	(3)	(3)	(3)	(3)
Pulpstones..........do....	(3)	(3)	180	11,130
Sand and gravel..........do....	11,918,217	6,048,619	6,987,761	4,278,251
Sand-lime brick..........thousands of brick..	(3 9)	(3 9)	(3 9)	(3 9)
Silver..........troy ounces.	442,063	300,067	365,175	259,680
Stone..........short tons..	2,329,020	2,020,445	2,347,190	1,941,820
Strontium minerals..........do....	....	....	(3)	(3)
Talc and ground soapstone..........do....	190	1,225	4	1,394
Tungsten ore (60-percent concentrates)..........do....	100	(3)	74	(3)
Zinc..........do....	10,131	1,053,624	11,560	1,456,560
Miscellaneous [10]..........	....	9,827,939	....	7,709,823
Total value, eliminating duplications..........	....	31,595,704	....	28,090,188

[1] Value not included in total value for State.
[2] Figures not available.
[3] Value included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[5] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] According to Bituminous Coal Division: value includes selling expenses.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Figures obtained through cooperation with Bureau of the Census.
[10] Includes minerals indicated by "[3]" above.

Mineral production of West Virginia, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Bromine ... pounds..	858,059	$140,910	1,152,237	$179,011
Calcium chloride ... short tons..	12,473	83,583	12,103	79,978
Cement ... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)..	------------	[2] 3,000,116	------------	[2] 2,451,000
Raw (sold by producers) ... short tons..	46,758	93,426	55,853	103,989
Coal ... do ..	[3] 108,361,984	[3] 190,492,164	[4] 126,437,621	[4] 231,603,584
Coke ... do....	1,686,070	[5] 4,699,840	2,133,003	[5] 6,170,849
Ferro-alloys ... do....	(1 5)	(1 5)	(1 5)	(1 5)
Grindstones and pulpstones ... do....	2,703	168,510	4,604	207,044
Iron, pig ... do....	853,229	(1 5)	941,299	(1 5)
Lime ... do....	249,987	1,461,002	278,300	1,727,844
Manganese ore ... long tons..	26	380	219	(1)
Marl, calcareous ... short tons.	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet..	159,226,000	63,194,000	188,751,000	76,085,000
Natural gasoline ... gallons.	52,272,000	2,017,000	58,782,000	1,848,000
Petroleum ... barrels..	3,580,000	6,000,000	3,444,000	6,400,000
Salt ... short tons..	144,727	773,988	144,312	701,953
Sand and gravel ... do....	1,968,852	2,036,020	2,297,610	2,240,650
Sand and sandstone (ground) ... do....	(1)	(1)	(1)	(1)
Stone ... do....	[7] 3,808,140	[7] 4,477,828	[7] 3,719,950	[7] 3,818,788
Sulfuric acid [8] ... do....	(1 5)	(1 5)	(1 5)	(1 5)
Miscellaneous [9] ...	------------	26,437,932	------------	31,257,639
Total value, eliminating duplications...	------------	276,084,118	------------	329,891,960

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Exclusive of unclassified stone in 1939 and of dimension limestone in 1940, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1" and "7" above.

Mineral production of Wisconsin, 1939–40

Product	1939		1940	
	Quantity	Value	Quantity	Value
Cement ... barrels..	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)..	------------	[2] $494,323	------------	[2] $326,000
Coke ... short tons..	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore—				
Sold to furnaces ... long tons..	1,173,828	3,526,980	1,227,840	3,290,889
Sold for paint ... do....	------------	------------	598	(1)
Lead ... short tons..	388	36,472	445	44,500
Lime ... do....	64,290	541,787	65,632	542,749
Marl, calcareous ... do....	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold..	(4)	(4)	(4)	(4)
Molybdenum ... pounds..	(1)	(1)	------------	------------
Ores (crude), etc.:				
Zinc ... short tons..	------------	------------	190,326	(5)
Zinc-lead ... do....	218,400	(5)	------------	------------
Pyrites ... long tons..	(1)	(1)	(1)	(1)
Sand and gravel ... short tons..	7,024,722	2,616,204	6,742,882	2,304,197
Sand and sandstone (ground) ... do....	(1)	(1)	(1)	(1)
Sand-lime brick ... thousands of brick..	(1 6)	(1 6)	(1 6)	(1 6)
Silica (quartz) ... short tons..	(1)	(1)	(1)	(1)
Stone ... do....	3,182,780	3,564,045	4,330,360	5,030,263
Zinc ... do....	5,904	614,016	5,770	727,020
Miscellaneous [7] ...	------------	4,993,978	------------	5,356,657
Total value, eliminating duplications ...	------------	12,704,942	------------	13,553,683

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Figures obtained through cooperation with Bureau of the Census.
[7] Includes minerals indicated by "1" above.

Mineral production of Wyoming, 1939–40

Product	1939 Quantity	1939 Value	1940 Quantity	1940 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	...	[2] $182,185	...	[2] $193,000
Raw (sold by producers) ... short tons	76,133	777,722	91,714	976,844
Coal ... do	[3] 5,373,289	[3] 10,753,533	[4] 5,808,042	[4] 11,944,261
Copper ... pounds	...	...	4,000	452
Feldspar (crude) ... long tons	6,726	25,008	7,833	29,128
Gems and precious stones	...	(5)	...	(5)
Gold ... troy ounces	583	20,405	740	25,900
Gypsum (crude) ... short tons	(1)	(1)	5,415	8,393
Iron ore ... long tons	587,892	(1)	831,314	(1)
Mica, scrap ... short tons	(1)	(1)	...	...
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	26,614,000	4,901,000	27,346,000	5,221,000
Natural gasoline ... gallons	30,961,000	1,575,000	33,380,000	1,271,000
Ores (crude), etc.:				
Copper ... short tons	...	...	30	(6)
Dry and siliceous (gold and silver) ... do	57	(6)	783	(6)
Petroleum ... barrels	21,454,000	18,150,000	25,711,000	20,600,000
Sand and gravel ... short tons	1,675,120	746,022	1,676,954	594,111
Silver ... troy ounces	75	51	114	81
Sodium sulfate (natural) ... short tons	(1)	(1)	(1)	(1)
Stone ... do	690,860	668,069	405,140	375,463
Tantalum ore ... pounds	(1)	(1)	...	...
Vermiculite ... short tons	(1)	(1)	(1)	(1)
Miscellaneous [7]	...	1,614,006	...	1,833,900
Total value, eliminating duplications	...	39,413,001	...	43,073,533

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. Total for 1940 is estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete.
[3] According to Bituminous Coal Division and Bureau of the Census; producers were asked to exclude selling expenses in reporting value, but a number of them included such expenses.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

PART II. METALS

GOLD AND SILVER

By CHAS. W. HENDERSON AND C. E. NEEDHAM

SUMMARY OUTLINE

SUMMARY

Gold and silver in 1941 failed to maintain the high rate of production set by the industry in 1940, which was a record year in many countries. World output of gold dropped an estimated 4 percent. Most of the slump is attributed to Europe; however, no reliable data have been obtained either on gold or silver from any of the European countries, and this is true as well for nearly all of the Asiatic nations and most of those in Africa and Oceania. World production of silver is estimated to have dropped nearly 3 percent, most of which represents reduced output in Canada, Mexico, and Peru.

Output of gold in North America dropped less than 1 percent in 1941. Although production in the United States decreased nearly 1 percent, increases were appreciable in Canada and Nicaragua. Silver made a poorer showing and dropped nearly 3 percent.

Among the gold-producing countries of the world, the Union of South Africa, with an output of more than 14,000,000 ounces, continued well in the lead and produced about 35 percent of total world output in 1941. The Union succeeded in increasing its output by 2½ percent in spite of losses of skilled workmen and engineers to military service, conversion of workshops to munition work, difficulty in obtaining steel, and increased working costs. This favorable showing was accomplished by extending the ordinary working hours, by amending leave arrangements, by working overtime, by practicing the strictest economy in the use of all stores, by using substitute materials wherever possible, by reducing replacements in equipment to a minimum, and by the restriction of development work.

In the United States less attention was given to gold and silver and more to base metals in order to meet the great demands of the war program. Early in 1942, the War Production Board asked gold and silver operators to give precedence to more essential operations to conserve mining material and supplies, and gold and silver mines were excluded from the priority benefits of Preference Rating Order P-56. This exclusion caused considerable disturbance and misunderstanding in the industry, and protests followed. In a short time it was stated that the case of each mine would be reviewed and if the mine was found to produce needed amounts of copper, lead, or zinc, its serial number would be reinstated.

Gold and silver producers in the Latin American countries faced an increasing shortage of mine and mill machinery, most of which comes from the United States. Moreover, their operations were handicapped by inadequate shipping facilities for their ores and concentrates to United States smelters. Naturally, it is expected that production will decrease still more in 1942.

Although gold and silver had been considered quite unessential to the war effort, late in 1941 they began to make many important contributions to industry. This applied especially to silver, of which surprising amounts were used in the war industries by 1942. A more detailed discussion in this connection is given later in this chapter.

DOMESTIC REFINERY PRODUCTION

The figures in the following table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two Bureaus.

The State totals are based upon bullion deposits in the United States mints and assay offices and upon returns to the Bureau of the Mint from smelting and refining companies. The State distribution is adjusted further by the Bureau of Mines from its geographical records of sources and production, both historical and current, from the producing mines and is tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in the United States mints and assay offices; (2) the domestic gold and silver in fine bars reported by private refineries, supplemented by data of content of unrefined mattes, blister copper, copper anodes, and lead bullion; and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

Gold and silver produced in the United States, 1937–41, and approximate distribution of source, by States and Territories, in 1941

[Refinery figures supplied by U. S. Bureau of the Mint]

State or Territory	Gold[1]		Silver[2]	
	Fine ounces	Value	Fine ounces	Value
1937	4,804,540	$168,158,900	71,941,794	$55,646,978
1938	5,089,811	178,143,400	62,665,335	40,510,924
1939	5,611,171	196,391,000	65,119,513	44,202,279
1940	6,003,105	210,108,700	69,585,734	49,483,189
1941:				
Alabama	32	1,100	4	3
Alaska	696,113	24,364,000	217,930	154,972
Arizona	317,386	11,108,500	7,711,716	5,483,887
California	1,431,637	50,107,300	2,167,280	1,541,177
Colorado	387,627	13,567,000	8,638,904	6,143,221
Georgia	307	10,700	35	25
Idaho	151,211	5,292,400	17,082,433	12,147,508
Illinois			501	356
Michigan			60,502	43,024
Missouri			152,273	108,283
Montana	252,683	8,843,900	12,742,114	9,061,059
Nevada	377,953	13,228,400	5,800,174	4,124,568
New Mexico	31,127	1,089,400	1,394,182	991,418
New York			37,262	26,497
North Carolina	3,313	115,900	7,342	5,221
Oregon	95,635	3,347,200	266,276	189,352
Pennsylvania	2,667	93,300	16,887	12,009
Philippine Islands	1,144,332	40,051,600	1,260,097	896,069
Puerto Rico	20	700	2	1
South Carolina	15,549	544,200	6,447	4,585
South Dakota	611,869	21,415,400	173,286	123,226
Tennessee	228	8,000	39,396	28,015
Texas	295	10,300	1,093,137	777,341
Utah	372,570	13,040,000	13,061,846	9,288,424
Virginia	240	8,400	134	95
Washington	83,166	2,910,800	405,820	288,583
Wyoming	459	16,100	49	35
	5,976,419	209,174,600	72,336,029	51,438,954

[1] Gold valued at $35 a fine ounce.
[2] Silver valued as follows 1937, $0.7735, 1938, $0.646+; 1939, $0.678787+; 1940 and 1941, $0.7111+.

Gold and silver produced in the United States, 1792–1941

[From Report of the Director of the Mint. The estimate for 1792-1873 is by R. W. Raymond, commissioner of mining statistics, and since then by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value[1]	Fine ounces	Value[2]
1792-1847	1,187,170	$24,537,000	309,500	$404,500
1848-72	58,279,778	1,204,750,000	118,568,200	157,749,900
1873-1941	207,958,229	4,851,125,300	3,610,431,694	2,715,323,848
	267,425,177	6,080,412,300	3,729,309,394	2,873,478,248

[1] Gold valued in 1934 and thereafter at $35 per fine ounce; prior thereto at $20.67+ per fine ounce. Dollar figures are rounded.
[2] Silver valued in 1934 and thereafter at Government's average buying price for domestic product: In 1934 and 1938 at $0.64+ per fine ounce, in 1935 at $0.71875, in 1936 at $0.7745, in 1937 at $0.7735, in 1939 at $0.678787+, and in 1940 and 1941 at $0.7111+.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.771.

PRICES OF GOLD AND SILVER

Gold.—Under the Gold Reserve Act of 1934 the value of gold was fixed by Presidential proclamation on January 31, 1934, at $35 per fine troy ounce and has remained at that figure through 1941. From January 18, 1837,[1] through 1932, the price was $20.67+ per ounce, and in 1933 the legal coinage value was continued at $20.67+. The average weighted price per fine ounce in 1933, as computed by the Bureau of Mines, was $25.56 and in 1934, $34.95. A complete account of regulations pertaining to gold and silver in 1933–34 is given in the chapter on Gold and Silver in Minerals Yearbook, 1934 (pp. 25–46), issued by the Bureau of Mines.

Silver.—The Government price for newly mined domestic silver was maintained throughout 1938 and to June 30, 1939, at $0.646464646+ per fine ounce. The act of Congress approved July 6, 1939, fixed the price of domestic silver mined after July 1, 1939, at $0.711+ per ounce. The annual average prices [2] used for domestic silver from 1932 to 1939 are as follows: 1932, $0.282; 1933, $0.350; 1934, $0.646464646+; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.646464646+; 1939, $0.678787878+; 1940–41, $0.711111111+.

The following table, copied from the Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1941, shows the price of silver in London and in New York in 1940 and the first half of 1941.

Price of silver in London and in New York, 1940–41

[From the Report of the Director of the Mint]

Month	London price per ounce, 0.925 fine			Average monthly exchange, New York on London	United States equivalent, per fine ounce, of London price, at current rate of exchange	Average monthly New York price of fine bar silver, per ounce (mean of bid and asked quotations)
	Highest	Lowest	Average			
1940	*Pence*	*Pence*	*Pence*	*Dollars*	*Dollar*	*Dollar*
January	22 5/8	21 1/16	21 8920	3 9639	0. 39089	0. 35062
February	21 13/16	20 3/16	20 9345	3 9633	. 37373	. 35062
March	21 5/16	20 1/16	20 7631	3. 7591	. 35158	. 35062
April	21 1/4	20 1/8	20 7130	3. 5259	. 32897	. 35062
May	23 1/2	20 7/8	21 8777	3 2736	. 32261	. 35261
June	23 1/2	21 1/8	22 6875	3 6016	. 36807	. 35137
July	22 5/8	21 11/16	22. 0951	3 8049	. 37869	. 35062
August	23 1/2	22 5/16	23 2613	3 9788	. 41690	. 35062
September	23 1/2	23 3/8	23 4464	4 0342	. 42607	. 35062
October	23 1/2	23 3/8	23. 4511	4 0325	. 42598	. 35062
November	23 1/2	22 7/8	23. 2381	4 0356	. 42243	. 35062
December	23 5/16	22 13/16	23. 0149	4 0350	. 41831	. 35062
1941						
January	23 3/8	23 3/16	23. 2727	4 0342	. 42291	. 35062
February	23 7/16	23 1/4	23. 3406	4 0297	. 42366	. 35062
March	23 1/2	23 3/16	23. 4226	4 0319	. 42539	. 35062
April	23 1/2	23 1/2	23. 5000	4. 0248	. 42605	. 35062
May	23 1/2	23 3/8	23 4574	4 0310	. 42593	. 35062
June	23 7/16	23 3/8	23. 4000	4. 0316	. 42495	. 35062
Average, calendar year 1940	----------	----------	22. 2921	3 8300	. 38458	. 35085
Average, fiscal year 1940–41	----------	----------	23. 2344	4. 0209	. 42082	. 35062

[1] For Congressional acts with reference to coinage from April 2, 1792, to January 31, 1934, see Minerals Yearbook, 1937, p. 113; for gold prices in London, 1931–36, p. 114.

[2] For highest, lowest, and average price of silver in New York, 1874–1935, see Minerals Yearbook, 1937, p. 115; for ratio of silver to gold, 1687–1935, p. 121.

UNITED STATES AND WORLD MONETARY STOCKS

According to figures published in the Federal Reserve Bulletin, the gold reserves of the United States increased $742,000,000 in 1941 and totaled $22,737,000,000 at the end of the year. The gain in 1941 was the smallest since the year before the legal value of gold was raised from $20.67+ to $35 a fine ounce. The record gain of $4,351,000,000 occurred in 1940, when much gold was acquired from European countries invaded by Germany. During the first 5 months of 1942 the gold reserves decreased slightly and were shown by the daily statement of the United States Treasury, June 8, 1942, to be 649,033,271.8 fine ounces valued at $22,716,164,513.90.

Figures on gold reserves held by central banks and governments in many of the other countries of the world at the end of 1941 are not available. At the end of 1939 the gold reserves (including stabilization funds) of all countries (including the United States) totaled approximately $29,122,000,000. Adding $1,419,000,000 for new gold produced in 1940 and an estimated $1,336,000,000 for 1941 raises the total reserves of the world to approximately $31,877,000,000.

The United States Treasury silver holdings on December 31, 1941, approximated 3,280,000,000 fine ounces. This represents slightly over 100,000 tons of silver. Early in 1942 it was stated that the Treasury would lend 40,000 tons of silver for electrolytic busbars for making magnesium and for certain other war uses. The Twenty-sixth Annual Review of the Silver Market, 1941, by Handy & Harman, contains the following paragraphs regarding coinage and Indian demand.

Accretions to the gold stocks of the United States were much less in 1941 than in recent years. Nevertheless, such additions were sufficient to prevent any but nominal progress towards the goal set by the Silver Purchase Act that "one-fourth of the total monetary value of the gold and silver stocks shall be in silver." Instead of the required 25 percent, the proportion of silver at December 31, 1941, was 15.7 percent, which compares with 15.6 percent one year before.

Coinage.—According to advices from London, the Royal Mint coined and exported substantial quantities of silver during 1941, but no amounts are ascertainable. It is believed that these shipments included coinage for the Dominions and the allies of Great Britain, although the major portion consisted of Maria Theresa thalers for Ethiopia and East Africa to replace the Italian money introduced five years previously.

In Latin America, Panama authorized the coinage of additional fractional silver pieces, and the Central Bank of Ecuador was instructed to mint 5-sucre and 2-sucre coins of silver instead of issuing paper notes for the needed expansion of currency. Mexico used only a scant 300,000 ounces in 1941 to make 1-peso and 20-centavo pieces, but the silver came out of stocks purchased in 1940 and not from newly mined metal. The United States supplied native coins for Liberia, the Dominican Republic, the Dutch possessions of Curaçao and Surinam, and the Netherlands East Indies.

Although the amount of foreign coinage done in this country was considerable, the necessity to operate our mints on a 24-hour basis was caused by the tremendous demand for United States fractional currency which developed during the year, and which, according to the Director of the Mint, was attributable to defense expansion in trade, increased popularity of vending machines, and sales taxes. Between January 1 and November 30, 1941, the value of subsidiary silver in circulation (this excludes nickels and pennies) increased by $61,500,000, equivalent to 44,500,000 ounces of newly coined metal. It is also of interest that during this same period an additional 8,600,000 ounces of silver in the form of standard silver dollars was withdrawn from the banks. However, no question of silver consumption for coinage is involved in this record-breaking demand for currency by the American people, since no specific Government purchases of metal were necessitated.

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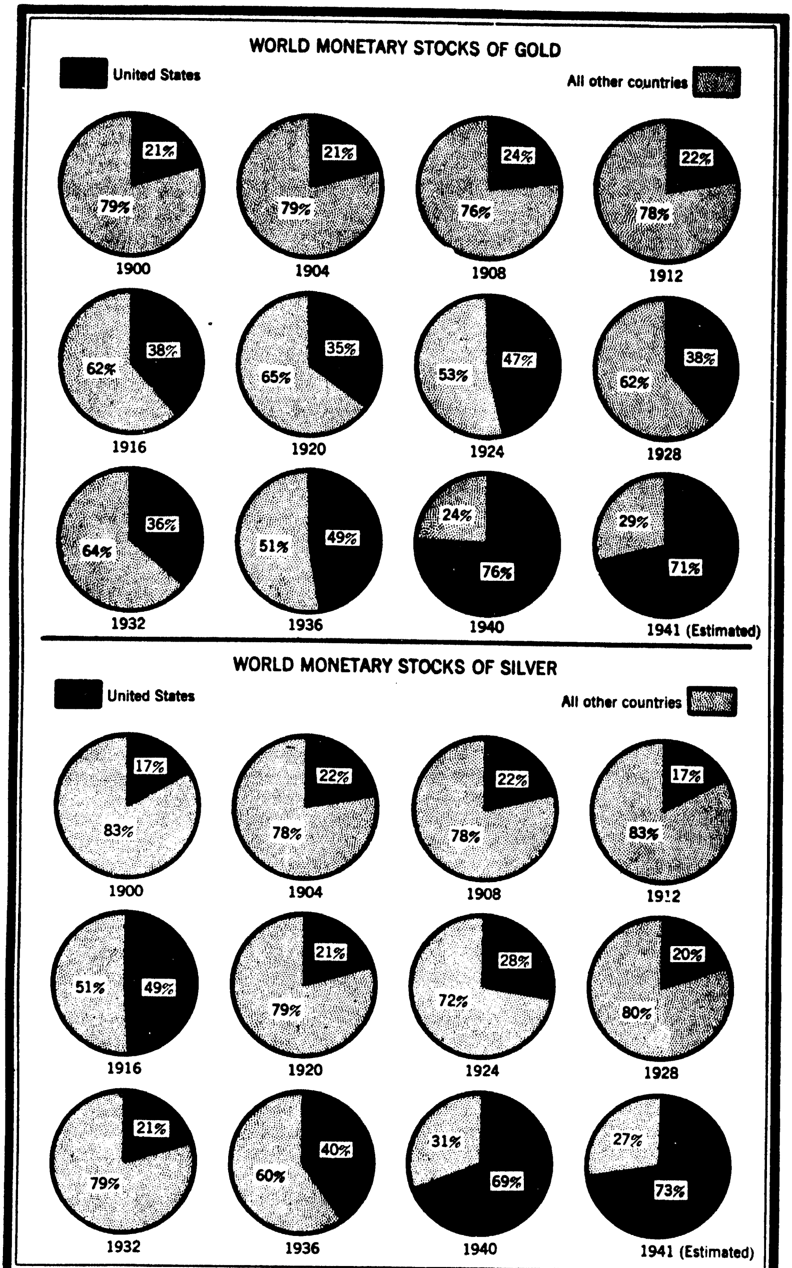

FIGURE 1.—World monetary stocks of gold and silver, 1900–1941.

Indian demand.—It has been impossible to compute statistically India's absorption of silver in 1941 because of the almost total lack of official figures or even estimates covering imports, exports, and Indian Government sales. The only pertinent information available is that in February and April 3,500,000 ounces were shipped to India from the United States and 875,000 ounces from Canada.

Also, it is believed that India acquired most of Burma's production and some 4,000,000 ounces from Australia. The sole basis for our estimate of Indian silver consumption in 1941 is an advice from Bombay which sets the figure at 40,000,000 ounces.

During the past year there has been no indication of any further hoarding of silver coin such as occurred in 1940; nor any criticism, so far as we have heard, of the debasement of the rupee. It would appear, therefore, that the steps taken by the Indian Government have satisfied the demand of the people for more currency and at the same time have provided surplus stocks of silver without the corresponding loss of foreign exchange which purchases abroad would have necessitated.

GOLD AND SILVER IN THE ARTS AND INDUSTRIES

Gold.—The average person doubtless regards gold as a special metal almost unavailable except for monetary, international trade, and exchange purposes. However, gold has a number of qualities that adapt it to many uses in industry, and it would seem that greater use might be made of the metal during the present emergency when there is a critical shortage of nearly all metals. The following comments on the uses of gold in the industries have been excerpted largely from an excellent paper by Downs.[3]

Gold has seven properties that make it particularly desirable in meeting many industrial needs: (1) Resistance to all ordinary corrosion; (2) high malleability and ductility; (3) ability to form a fast joint with ceramics; (4) ability to weld at ordinary temperatures by pressure alone; (5) very low specific heat and latent heat of fusion, making it about the easiest of the ordinary metals to heat, cool, or melt; (6) attractive color, either in the nearly pure form or as numerous alloys; (7) high conductivity for electricity.

The use of gold in jewelry is well-known. The two properties accounting mainly for the popularity of gold in articles of jewelry are attractive color and freedom from corrosion. In addition to yellow gold, white, green, blue, and purple gold can be produced. By adding varying amounts of silver, copper, zinc, nickel, or palladium, white gold is produced; adding cadmium, green gold; adding iron, blue gold; adding aluminum, purple gold.

Many articles are prepared by covering the surfaces with a layer of gold by one of the several processes described below. Gilding by the older mercurial and immersion processes has been largely replaced by electroplating. The article to be plated is made the cathode (negative pole) and a bar of gold the anode (positive pole) in a bath of potassium aurocyanide. Any thickness of plate may be obtained by controlling the operation. A thickness of 0.00005 inch is satisfactory on many articles. Gold-covered silver wire may be prepared by plating a bar of silver-copper alloy and drawing it out to wire in the usual manner. This common commodity is used for weaving into gold braid and embroideries so widely used on uniforms, vestments, and other articles. Plated gold also finds much application in instruments used in the transmission of sound, the efficiency of which depends upon the delicate electrical contact of gold-plated electrodes.

In covering surfaces with leaf gold, the extreme malleability of gold is utilized. Most leaf gold is prepared by hand-hammering the metal

[3] Downs, E., Gold and Its Scope in Industry: Chem. and Ind., vol. 61, No 14, April 4, 1942, pp. 156-160.

into sheets about four-millionths inch thick, and the leaf can be applied to nearly all kinds of surfaces. About 250 square feet of leaf can be prepared from 1 ounce of gold at a cost for the gold of about one-tenth cent per square inch. The low cost permits the leaf to be used extensively on picture frames, gilt labels of many kinds, book titles and coverings, the edges of playing cards, and numerous other articles.

The process of depositing a layer of gold by cathode sputtering or cathode dispersion has been developed rather recently. The method is applicable to articles of many different shapes, sizes, and materials. To be coated, the article is placed in a vacuum chamber provided with an aluminum anode and a gold cathode. On passing an electric current of high voltage through the chamber, gold is dispersed and deposited as a film less than one-millionth inch thick. Sputtered gold parts are used extensively in radio equipment.

The vaporization process is also used to coat objects with gold. Again, the object is placed in a vacuum chamber which also contains gold. The gold is heated electrically to its melting point, and the vapor is condensed as a molecular film on the object. Spectacle lenses processed in this way are used in the treatment of certain eye complaints.

Still another method of covering a surface with a layer of gold is through the use of rolled gold, prepared by soldering or welding gold plate of any carat onto a block of bronze, nickel silver, or silver. The block is then rolled to the desired thickness even to a covering of no more than two-millionths inch thick. Common articles made of rolled gold include spectacle frames, watch cases, pencils, jewelry, and toys. Articles with the thicker coverings have very high wearing qualities.

An interesting and important use of gold is in decorating ceramic ware. Gold applied in this way is virtually pure gold, even to the finest line. The decorating usually is done in one of two ways. In the first, the gold is prepared chemically in the amorphous form and amalgamated. Fluxes are added, and the whole is ground to a fine powder. The powder is next mixed with a suitable liquid and applied to the ware; the ware is then fired in the kiln. In the second method, a solution is prepared of complex organic gold compounds in essential oils, with materials added to give good adhesion. The solution is applied to the ware with a brush, and the ware is fired. More ware is decorated by this method than by the first. Attractive shades of ruby and rose in stained glass, jewelers' enamel, china, and porcelain ware are developed by the use of purple of Cassius (gold precipitated from a solution of gold chloride by adding stannous chloride).

The use of gold in the practice of dentistry is also well-known. Gold is a desirable dental material because it is permanent and has natural resistance to mouth secretions. It is used mainly in three ways—as fillings, dentures, and orthodentic wires. For certain types of dental work the gold is hardened by adding platinum or palladium.

Gold finds considerable use for chemical plant and laboratory ware, although the high cost of the metal limits its use considerably. Laboratory dishes and crucibles of gold-palladium alloy resist heat and chemicals, and the alloy can be substituted for platinum in many processes when the price of platinum is unduly high. Some plant equipment constructed of base metals is lined with gold to give greater resistance to the chemicals, and solid-gold stills and condensers are not unknown. Gold-platinum alloy is used to make spinnerets in the

manufacture of artificial silk, as the metal used must resist abrasion and corrosion during passage of the solution through the spinneret.

Gold also finds use in several types of special instruments, including the Pallador thermocouple—a gold-palladium-iridium-platinum couple—used for accurate temperature measurements; heat fuses, either as the pure metal or as a gold-palladium alloy, in certain electrically heated furnaces to provide protection from 960°C. to 1,500°C.; and contacts in certain electrical equipment, generally as a gold-silver-platinum alloy.

Other special commodities are made of gold because of its high resistance to corrosion. These include gold-alloy hairsprings used in highly accurate timepieces and marine chronometers; suspension strips in the most accurate galvanometers; gold plate on base-metal conductors carrying high-frequency radio currents; and gold-tipped pencils on water-meter recorders used in damp climates.

Still other interesting applications are made of gold in parabolic reflectors using infrared rays to dry paint work and as a gold alloy for brushes in motor generators employed in connection with electrical equipment that measures the speed of aircraft engines.

In therapeutics gold serves unusually well as a target in X-ray work, as container tubes for the distintegration products of radon in radium therapy, and, in the form of complex organic salts, in the treatment of certain skin diseases and rheumatoid arthritis.

Silver.—The utilization of silver in the arts and industries has shown a phenomenal increase during the past few years. Consumption has leaped from about 5,000,000 fine ounces in 1935 to some 72,000,000 fine ounces in 1941, and it is expected that consumption in 1942 will be substantially greater than in 1941. Naturally, much of this increased demand is due directly or indirectly to the war program.

Silver has many properties that make it valuable for uses in the arts and industries. For example, it is highly malleable and ductile; it ranks first among the metals in conductivity of electricity and heat; it is beautiful and has ability to take a superior finish; it is but slightly affected by common acids and is not ordinarily discolored or stained by foods and fruit juices; and it is low in cost compared with other precious, and even some base, metals.

Although nearly pure silver has many applications, it is too soft for most purposes, hence is alloyed with other metals in varying proportions. It is also used in many articles as a plating or coating on base metals or base-metal alloys. Plating is now done almost entirely by the electro method. Compounds of silver find much use in the photographic industry, as well as in medicine and chemistry.

For many years the greatest consumer of silver has been the sterling silverware industry, which in 1941 used an estimated 30,000,000 fine ounces. ("Sterling" has a fineness of 0.925, or 92.5 percent pure silver.) This amount is considerably more than double that consumed by this industry in 1940 and is attributed in great part to increased purchasing power of the public and to the greater number of marriages as a result of enlistments and inductions into the service.

The photographic industry for a number of years has ranked second in consumption of silver, followed generally by the electroplating industry, the manufacture of jewelry, optical goods and novelties, silver-clad steel tanks, evaporators, drying pans, and other equipment

for the chemical industry, and several smaller industries and uses that have consumed annually less than 1,000,000 fine ounces each.

In 1941 the war industries and others began using increasing amounts of silver; in 1942 war uses of the metal are expanding rapidly. This trend was brought about by the substitution of silver in many articles formerly made of nickel, chromium, aluminum, copper, and tin and by the industries employing silver in new ways because of the desirable properties that it possesses.

Of particular importance was the greatly increased use of silver solder and brazing alloys, which are made in a wide variety of types containing 10 to 80 percent silver, with the remainder copper, zinc, or other metals. Those in greatest use contain 40 to 50 percent silver

The silver solders and brazing alloys are of great moment in the war effort. They are used in ignition-wire shields for aircraft engines, preventing radio interference; in the manufacture of oil coolers and radiators for airplane engines; and in airplane instruments, pipe connections, parts of the fuselage, and repair work. In armament, they are employed in joining the cylinder heads in the recoil mechanisms of antiaircraft guns and field artillery pieces; in the brazing of jackets of machine guns; in the construction of torpedo tubes; and in joining the nose pieces of aerial and incendiary bomb shells and tubes. Silver brazing alloys are widely used in the construction, maintenance, and repair of ships in joining pipes, and in equipment for air conditioning and refrigeration; also, in the construction of motors, and headlight connections and pneumatic systems of automobiles; and in the assembling of parachute rip rings and the brazing of joints of army field-kitchen stoves. Numerous other uses are made of silver solder and silver brazing alloys in a wide variety of electrical equipment and appliances.

A new and important use of silver is the plating of aircraft bearings, which are coated with a thickness of 0.025 inch. This use alone probably will consume more than 5,000,000 ounces in 1942. Coin silver (90 percent pure silver) is being employed to form seals and cushion ends for pistons in the recoil chambers of antiaircraft guns and field-artillery pieces, and 9½ pounds of silver goes into the recoil mechanism of each 155-mm. gun and each 8-inch howitzer.

Silver is replacing tin in soft tin-lead solders and in high-tin Babbitt metal; nickel silver in the manufacture of watch cases; tin-antimony alloys in costume jewelry; aluminum as a reflective coating for "sealed-beam" headlights and in vacuum bottles; and brass in many important ways. It is being substituted for copper in low-voltage wiring and in busbars so extensively employed in plants manufacturing aluminum and magnesium. Silver alloyed with about 10 percent copper finds much use in electrical contacts, for which it is well-adapted because of its high conductivity of electricity and heat; too, the oxide formed at some contacts decomposes at 572° F. and returns to pure silver and thus does not build up high resistance.

Silver added in small amounts to copper improves copper to be soldered by preventing undue softening from heat; in commutator bars by insuring hardness; and in photoengravers' plates by preventing softening of the cold-rolled copper sheets processed at increased temperatures.

An alloy containing 4 percent silver has gained some commercial use as a master alloy to introduce silver into stainless steel. The

silver tends to decrease pit corrosion and to give a better surface polish.

Some progress has been made in casting silver articles weighing up to 2 ounces. Success in this field will lead to many industrial applications.

Finally, silver in various forms has considerable use in dentistry, medicine, and surgery as instruments of many types, suture wires and plates, dental fillings, cauterizing devices, and compounds used for caustic, astringent, and antiseptic purposes.

It is evident that silver occupies an important place in the war program, and the extensive research now being made on the metal undoubtedly will develop many new uses within a short time. The stockpile, once considered to be large, is disappearing at a rapid rate, and the metal is speedily taking its place with numerous other metals whose nonessential uses are being seriously curtailed or prohibited; not often has a commodity readjusted its position in commerce so abruptly.

The following table shows the net industrial consumption of gold and silver in the United States from 1901 to 1941, inclusive, in terms of dollars for gold and fine ounces for silver. The amount of each metal reclaimed and recovered from various sources is deducted from the amount issued for industrial use to give the net amount.

Net industrial consumption of gold and silver in the United States, 1901–41 [1]

Year	Gold (dollars)			Silver (fine ounces)		
	Returned from industrial use	Issued for industrial use	Net industrial consumption	Returned from industrial use	Issued for industrial use	Net industrial consumption
1901	5, 237, 013	23, 868, 956	18, 631, 943	1, 223, 720	14, 133, 694	12, 909, 974
1902	6, 576, 863	27, 682, 847	21, 105, 984	2, 798, 880	19, 345, 009	16, 546, 129
1903	6, 459, 989	29, 063, 551	22, 603, 562	3, 934, 270	19 968, 356	16, 034, 086
1904	7, 880, 964	28, 655, 963	20, 774, 999	2, 659, 153	20, 479, 987	17, 820, 834
1905	7, 733, 423	33, 208, 615	25, 475, 192	4, 391, 923	23, 700 677	19, 308, 754
1906	7, 243, 829	39, 126, 763	31, 882, 934	3, 909, 030	21, 853, 264	17, 944, 234
1907	9, 259, 254	40, 727, 070	31, 467, 816	2, 298, 742	24, 369, 784	22, 071, 042
1908	7, 030, 294	31, 476, 091	24, 445, 797	3, 589, 929	23, 850, 828	20, 260, 899
1909	7, 380, 560	37, 628, 769	30, 248, 209	6, 941, 962	27, 901, 126	20, 959, 164
1910	7, 626, 278	41, 787, 152	34, 160, 874	1, 602, 979	24, 789, 807	23, 186, 828
1911	7, 731, 238	40, 834, 292	33, 103, 054	5, 725, 582	32, 013, 685	26, 288, 103
1912	8, 106, 705	43, 977, 257	35, 870, 552	7, 291, 699	29, 936, 520	22, 644, 821
1913	8, 362, 235	45, 864, 066	37, 501, 831	7, 864, 466	30, 992, 834	23, 128, 368
1914	12, 934, 974	36, 137, 075	23, 202, 101	6, 758, 330	29, 309, 961	22, 551, 631
1915	12, 698, 326	36, 126, 353	23, 428, 027	7, 001, 875	29, 968, 115	22, 966, 240
1916	20, 185, 304	50, 042, 175	29, 856, 871	9, 899, 246	32, 103, 507	22, 204, 261
1917	19, 082, 196	50, 415, 641	31, 333, 445	11, 041, 038	27, 039, 845	15, 998, 807
1918	20, 327, 345	53, 014, 385	32, 687, 040	9, 530, 263	36, 252, 596	26, 722, 333
1919	21, 035, 398	76, 132, 251	55, 096, 853	6, 463, 002	32, 700, 521	26, 237, 519
1920	29, 534, 478	79, 715, 087	50, 180, 609	8, 694, 392	27, 974, 521	19, 280, 129
1921	28, 013, 868	48, 455, 477	20, 441, 609	7, 024, 318	35, 867, 946	28, 843, 628
1922	24, 683, 403	56, 613, 658	31, 930, 255	6, 623, 568	37, 910, 099	31, 286, 531
1923	31, 265, 070	66, 892, 245	35, 627, 175	8, 469, 806	36, 824, 977	28, 355, 171
1924	32, 320, 145	64, 791, [illegible]	32, 471, 295	8, 930, 580	33, 594, 816	24, 664, 236
1925	30, 092, 021	61, 225, 870	31, 133, 849	9, 897, 416	39, 826, 579	29, 929, 163
1926	32, 063, 448	62, 990, 839	30, 927, 391	10, 000, 792	39, 408, 393	29, 407, 601
1927	30, 369, 237	56, 819, 728	26, 450, 491	10, 155, 427	38, 648, 717	28, 493, 290
1928	30, 276, 159	56, 581, 65[illegible]	26, 305. 500	10, 616, 380	35, 547, 663	24, 931, 283
1929	32, 030, 531	56, 903, 667	24, 873, 136	11, 381, 523	42, 359, 082	30, 977, 559
1930	27, 511, 640	42, 689, 379	15, 177, 739	9, 468, 829	36, 343, 207	26, 874, 378
1931	23, 227, 085	29, 157, 865	5, 930, 780	9, 346, 281	33, 682, 119	24, 335, 838
1932	26, 594, 769	20, 105, 102	−6, 489, 667	9, 796, 956	24, 257, 967	14, 461, 011
1933	22, 805, 960	17, 013, 260	−5, 792, 700	18, 532, 880	29, 343, 451	10, 810, 571
1934	75, 927, 285	14, 232, 795	−61, 694, 490	28, 186, 178	39, 678, 603	11, 492, 425
1935	58, 390, 675	25, 929, 497	−32, 461, 178	35, 903, 107	41, 192, 023	5, 288, 916
1936	35, 875, 770	32, 967, 937	−2, 907, 833	16, 703, 35[illegible]	35, 842, 674	19, 139, 321
1937	36, 407, 945	39, 622, 338	3, 214, 393	23, 564, 986	51, 292, 270	27, 727, 284
1938	30, 480, 835	30, 156, 754	−324, 081	18, 438, 847	38 620, 473	20, 181, 626
1939	31, 328, 360	38, 788, 960	7, 460, 600	24, 972, 260	69, 585, 265	44, 613, 005
1940	27, 872, 355	41, 178, 387	13, 306, 032	22, 563, 729	67, 062, 632	44, 498, 903
1941	30, 975, 490	67, 977, 110	37, 001, 620	20, 361, 256	92, 793, 574	72, 432, 318

[1] U. S. Bureau of the Mint.

IMPORTS AND EXPORTS

Value of gold and silver imported into and exported from the United States, 1940–41, by classes

	Imports	Exports	Excess of imports over exports
1940			
Gold:			
Contained in ore and base bullion	$110,935,025	$103,922	$110,831,103
Bullion refined	4,115,289,974	1,016,218	4,114,273,756
United States coin	9,057	6,347	2,710
Foreign coin	523,233,147	3,868,412	519,364,735
	4,749,467,203	4,994,899	4,744,472,304
Silver:			
Contained in ore and base bullion	21,069,295	4,030	21,065,265
Bullion refined	36,916,258	3,343,184	33,573,074
United States coin	217,964	7,790	210,174
Foreign coin	230,349	319,381	[1] 89,032
	58,433,866	3,674,385	54,759,481
1941 (Jan.–Sept.)			
Gold:			
Contained in ore and base bullion	78,807,762	30,973	78,776,789
Bullion refined	759,476,500	12,180	759,464,320
United States coin	728	8,114	[1] 7,386
Foreign coin	434,034		434,034
	838,719,024	51,267	838,667,757
Silver:			
Contained in ore and base bullion	12,961,787	1,159	12,960,628
Bullion refined	22,671,365	2,706,334	19,965,031
United States coin	115,943	171,000	[1] 55,057
Foreign coin	1,703	2,251,097	[1] 2,249,394
	35,750,798	5,129,590	30,621,208

[1] Excess of exports.

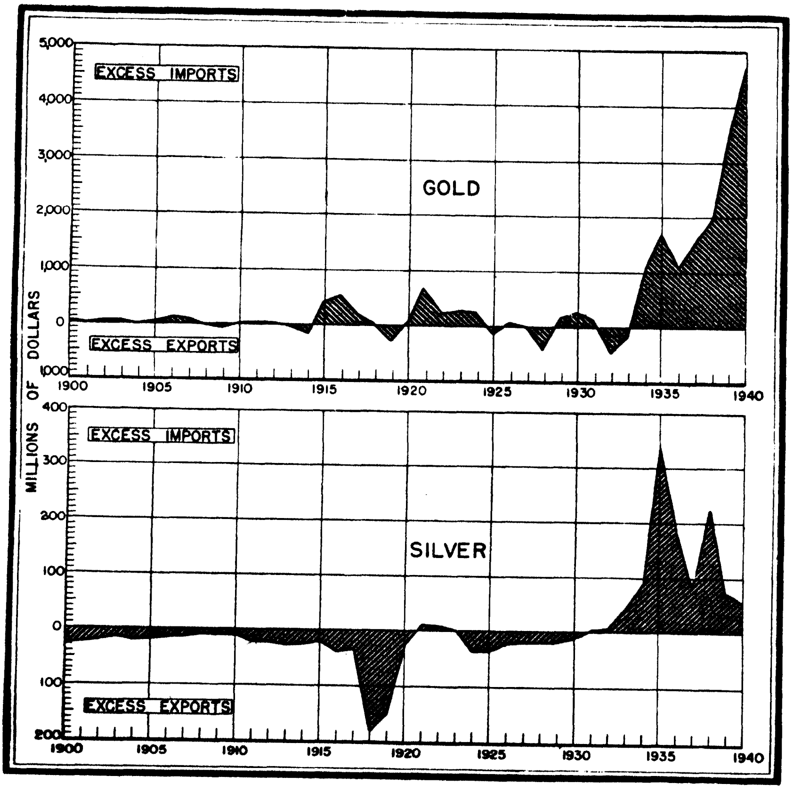

FIGURE 2.—Gold and silver imports and exports, with net movements, 1900–1940.

DOMESTIC SUPPLY

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel. These two sources yielded 90 percent of the domestic gold (excluding Philippine Islands and Puerto Rico) in 1915, 80 percent in 1930, 87 percent in 1931, 93 percent in 1932, 1933, and 1934, 91 percent in 1935, 88 percent in 1936, 85 percent in 1937, 90 percent in 1938, 88 percent in 1939, 87 percent in 1940, and 86 percent in 1941. The proportionate output of gold from copper ore was 7 percent in 1915, 16 percent in 1930, 10 percent in 1931, 4 percent in 1932, 5 percent in 1933 and 1934, 7 percent in 1935, 10 percent in 1936, 12 percent in 1937, 8 percent in 1938, 10 percent in 1939, 11 percent in 1940, and 12 percent in 1941. These sources represented 96 to 98 percent of the gold supply in 1915 and 1930–41.

In 1915 dry and siliceous ore yielded in rounded figures 36 percent of the total silver; copper ore, 26 percent; lead ore, 27 percent; and zinc-lead ore, 9 percent. In 1940 dry and siliceous ores yielded 41 percent and in 1941, 41 percent; copper ore, 29 and 28 percent; lead ore, 4 and 6 percent; and zinc-lead ore (including zinc-copper and zinc-lead-copper ores), 24 and 25 percent.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the official refinery figures for production of gold and silver in the United States from 1937 to 1941, as agreed upon by the Bureau of the Mint and the Bureau of Mines. These figures record the output of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace the gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines systematically investigates the "mine production" of ores containing gold and silver and the output of the placer mines, the total being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two systems for ascertaining the production of gold and silver, one is a measure of the metallurgic industry and the other of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce identical results, but data for a period of years long enough to compensate for overlap or lag should agree within allowable limits of error.

Gold and silver produced in the United States, 1905–41, in fine ounces, according to mint and mine returns, in terms of recovered metals

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905–36	109, 420, 194	1, 826, 086, 989	109, 190, 585	1, 815, 780, 860
1937	4, 804, 540	71, 941, 794	4, 834, 062	72, 128, 397
1938	5, 089, 811	62, 665, 335	5, 170, 743	62, 873, 450
1939	5, 611, 171	65, 119, 513	5, 672, 485	65, 565, 024
1940	6, 003, 105	69, 585, 734	5, 984, 163	71, 824, 746
1941	5, 976, 419	72, 336, 029	5, 881, 798	68, 483, 333
	136, 905, 240	2, 167, 735, 394	136, 733, 836	2, 156, 655, 810

Compared with the mine reports, the mint reports for the 37 years show a total excess of gold of 171,404 ounces (a difference of 0.13 percent) and a total excess of silver of 11,079,584 ounces (a difference of 0.51 percent).

UNITS OF MEASUREMENT

All tonnage figures are short tons of 2,000 pounds "dry weight"; that is, they do not include moisture. The weight unit for gold and silver is the troy ounce (480 grains). The totals are calculated upon the basis of recovered and recoverable fine gold and silver shown by assays to be contained in ore, bullion, and other material produced. Prices of gold and silver are discussed in a preceding section of this report.

MINES PRODUCING

LEADING GOLD PRODUCERS

The output of the 35 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1941, none of which produced less than 19,000 ounces, was 2,528,312 fine ounces (53 percent of the total). Six of the companies, working placer mines with floating connected-bucket dredges, recovered 484,227 ounces of gold; the rest of the output of the largest producers came from lode mines. The total output of lode mines and placers producing less than 19,000 ounces each was 2,222,553 ounces.

Largest producers of gold in the United States in 1941, in order of output [1]

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co.	South Dakota	Whitewood	Dry and siliceous gold ore.
2	Utah Copper Co.	Utah	West Mountain	Copper ore.
3	United States Smelting, Refining & Mining Co.	Alaska	Fairbanks and Nome	Dredging gravel.
4	Golden Cycle Corporation [2]	Colorado	Cripple Creek, etc.	Dry and siliceous gold ore.
5	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Copper ore.
6	Yuba Consolidated Gold Fields	California	Callahan, Oroville, Snelling, Yuba River.	Dredging gravel.
7	Alaska Juneau Gold Mining Co.	Alaska	Juneau	Dry and siliceous gold ore.
8	Idaho Maryland Mines Corporation.	California	Grass Valley-Nevada City.	Do.
9	Natomas Co.	do	Folsom	Dredging gravel.
10	Empire Star Mines Co., Ltd.	do	Browns Valley, Grass Valley-Nevada City.	Dry and siliceous ore.
11	Getchell Mine, Inc.	Nevada	Potosi	Do.
12	Howe Sound Co.	Washington	Chelan Lake	Copper ore.
13	Lava Cap Gold Mining Corporation.	California	Grass Valley-Nevada City.	Dry and siliceous ore.
14	Alaska-Pacific Consolidated Mining Co.	Alaska	Willow Creek	Dry and siliceous gold ore.
15	Nevada Consolidated Copper Corporation.	Nevada	Robinson	Copper ore.
16	Mammoth-St. Anthony, Ltd.	Arizona	Old Hat	Dry and siliceous ore.
17	United States Smelting, Refining & Mining Co. (Gold Road).	do	San Francisco	Do.
18	Snyder Mines, Inc.	Utah	Camp Floyd	Do.
19	United States Smelting, Refining & Mining Co.	do	West Mountain and Tintic.	Zinc-lead ore, lead ore, dry and siliceous gold-silver ore.
20	Consolidated Coppermines Corporation.	Nevada	Robinson	Copper ore.

[1] Philippine Islands excluded.
[2] Custom mill. Includes mainly ore from Cresson, Portland, Ajax, Vindicator, and other mines in Cripple Creek district, Colorado, but also from other districts in Colorado.

Largest producers of gold in the United States in 1941, in order of output—Contd.

Rank	Operator	State	Mining district	Source of gold
21	Bald Mountain Mining Co.	South Dakota	Trojan	Dry and siliceous gold ore.
22	Gold Hill Dredging Co	California	Camanche, Oroville	Dredging gravel.
23	Central Eureka Mining Co	do	Mother Lode	Dry and siliceous ore.
24	Capital Dredging Co	do	Folsom	Dredging gravel.
25	New Jersey Zinc Co., Empire Zinc Division.	Colorado	Battle Mountain	Copper ore.
26	Knob Hill Mines, Inc	Washington	Republic	Dry and siliceous gold ore.
27	Talache Mines, Inc	Idaho	Middle Boise	Do.
28	Argonaut Mining Co., Ltd	California	Mother Lode	Dry and siliceous ore.
29	Golden Queen Mining Co	do	Mojave	Do.
30	Carson Hill Gold Mining Corporation.	do	Mother Lode	Do.
31	Telluride Mines, Inc. ormerly Veta Mines, Inc.).	Colorado	Upper San Miguel	Dry and siliceous gold-silver ore.
32	Anaconda Copper Mining Co.	Montana	Summit Valley or Butte.	Copper ore, zinc-lead ore, dry and siliceous gold-silver ore.
33	Manhattan Gold Dredging Co.	Nevada	Manhattan	Dredging gravel.
34	Anaconda Copper Mining Co. (West Mayflower mine).	Montana	Renova	Dry and siliceous gold ore.
35	Prescott Lease (E. L. Cord)	Nevada	Silver Peak	Dry and siliceous ore

LEADING SILVER PRODUCERS

The output of silver from the 50 leading silver-producing companies in 1941, none of which produced less than 199,000 ounces, was 53,638,081 ounces—80 percent of the total mine output of the United States (Philippine Islands and Puerto Rico excluded); the remaining 13,426,788 ounces (placer production excluded) came from about 5,000 lode mines, many of which derive a substantial net income from the silver content.

Largest producers of silver in the United States in 1941, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Anaconda Copper Mining Co.	Montana	Summit Valley or Butte.	Copper ore, zinc-lead ore, dry and siliceous gold-silver ore.
2	Sunshine Mining Co	Idaho	Evolution	Dry and siliceous silver ore.
3	New Jersey Zinc Co., Empire Zinc Division.	Colorado	Battle Mountain	Copper ore.
4	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Do.
5	United States Smelting, Refining & Mining Co.	Utah	West Mountain and Tintic.	Zinc-lead ore, lead ore, dry and siliceous gold-silver ore.
6	Utah Copper Co	do	West Mountain	Copper ore.
7	Bunker Hill & Sullivan Mining & Concentrating Co	Idaho	Yreka	Zinc-lead ore, dry and siliceous silver ore.
8	Tintic Standard Mining Co.	Utah	Tintic	Dry and siliceous silver ore, lead ore.
9	Coeur d'Alene Mines Corporation.	Idaho	Evolution	Dry and siliceous silver ore.
10	Federal Mining & Smelting Co.	do	Hunter and Yreka	Zinc-lead ore, lead ore.
11	Silver King Coalition Mines Co.	Utah	Uintah	Zinc-lead ore.
12	American Metal Co. (Presidio mine).	Texas	Shafter	Dry and siliceous silver ore.
13	Polaris Mining Co	Idaho	Evolution	Do.
14	Hecla Mining Co	do	Lelande	Zinc-lead ore, lead ore.
15	Triumph Mining Co	do	Warm Springs	Zinc-lead ore

Largest producers of silver in the United States in 1941, in order of output—Con.

Rank	Operator	State	Mining district	Source of silver
16	Desert Silver, Inc	Nevada	Silver Peak	Dry and siliceous ore.
17	Emperius Mining Co	Colorado	Creede	Dry and siliceous silver ore.
18	Park City Consolidated Mines Co	Utah	Blue Ledge	Zinc-lead ore.
19	Anaconda Copper Mining Co. (Flathead mine)	Montana	Hog Heaven	Dry and siliceous silver ore, lead ore.
20	Lexington Mining Co	do	Montana (Neihart)	Do.
21	Magma Copper Co	Arizona	Pioneer	Copper ore, zinc-copper ore.
22	New Park Mining Co	Utah	Park City	Zinc-lead ore.
23	Combined Metals Reduction Co	Nevada	Pioche	Do.
24	Chief Consolidated Mining Co	Utah	Tintic	Dry and siliceous gold-silver ore, zinc-lead ore, lead ore.
25	Blackhawk Consolidated Mines Co	New Mexico	Mogollon	Dry and siliceous gold-silver ore
26	West Coast Mines, Inc	Nevada	Barrett Springs	Dry and siliceous ore
27	Park Utah Consolidated Mines Co.	Utah	Park City	Zinc-lead ore, lead ore
28	Shattuck Denn Mining Corporation	Arizona	Warren	Copper ore, zinc-lead ore.
29	Cactus Mines Co	California	Mojave	Dry and siliceous ore
30	St Joseph Lead Co	Missouri	Southeastern Missouri	Lead ore.
31	Ground Hog Unit, American Smelting & Refining Co.	New Mexico	Central	Zinc-lead ore, lead ore, copper ore
32	Anaconda Copper Mining Co (Emma and Ophir)	Montana	Summit Valley or Butte	Zinc-lead ore, manganese-zinc-lead ore.
33	Lava Cap Gold Mining Corporation	California	Grass Valley-Nevada City.	Dry and siliceous ore.
34	Telluride Mines, Inc (formerly Veta Mines, Inc).	Colorado	Upper San Miguel	Dry and siliceous gold-silver ore.
35	American Smelting & Refining Co. (Trench Unit)	Utah	Harshaw	Zinc-lead ore.
36	Philipsburg Mining Co	Montana	Flint Creek	Dry and siliceous gold-silver ore
37	Combined Metals Reduction Co. (Park-Bingham group)	Utah	West Mountain	Zinc-lead ore, dry and siliceous gold ore, dry and siliceous gold-silver ore
38	Lessees of the Tonopah Mining Co. of Nevada	Nevada	Tonopah	Dry and siliceous ore
39	Shenandoah-Dives Mining Co.	Colorado	Animas	Zinc-lead ore.
40	Bristol Silver Mines Co	Nevada	Jack Rabbit	Lead ore.
41	Iron King Mining Co	Arizona	Big Bug	Zinc-lead ore, dry and siliceous gold-silver ore.
42	Summit King Mines, Ltd	Nevada	Sand Springs	Dry and siliceous ore.
43	Sherman Lead Co	Idaho	Lelande	Lead ore
44	Combined Metals Reduction Co (West Calumet mine).	Utah	Rush Valley	Zinc-lead ore, lead ore, dry and siliceous gold-silver ore
45	DeLamar Mining & Milling Co.	Idaho	Carson	Dry and siliceous gold-silver ore
46	Florence Mining Co	Montana	Montana (Neihart)	Dry and siliceous silver ore.
47	Golden Queen Mining Co	California	Mojave	Dry and siliceous ore
48	Sullivan Mining Co (Star mine)	Idaho	Hunter	Zinc-lead ore.
49	The Exploration Syndicate, Inc.	New Mexico	Steeple Rock	Dry and siliceous gold-silver ore
50	South Mountain Mining Co	Idaho	South Mountain	Zinc ore, copper ore

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1940 and 1941. The placers are those in which gold and silver in natural alloy and, in a few placers, platinum are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those yielding gold and silver from ore as distinguished from gravel, mainly from under-

ground workings, and include those that yield ore mined chiefly for copper, lead, or zinc but that contribute the precious metals as byproducts. In addition to the producing mines enumerated here many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of lode mines, because some are operated only temporarily and are individually small. As far as possible the unit, as for lode mines, is not the operator but the mining claim or group of claims.

Number of mines in the United States producing gold and silver, 1940–41, by States

State	Lode		Placer		Total	
	1940	1941	1940	1941	1940	1941
Alabama	2	2			2	2
Alaska	73	56	1,069	799	1,142	855
Arizona	1,024	805	276	184	1,300	989
California	1,030	835	836	724	1,866	1,559
Colorado	691	579	439	324	1,130	903
Georgia	7	7	14	11	21	18
Idaho	378	329	548	524	926	853
Illinois	3	4			3	4
Indiana			1		1	
Michigan	2	1			2	1
Missouri	3	3			3	3
Montana	687	612	285	325	972	937
Nevada	895	799	115	78	1,010	877
New Mexico	164	145	179	103	343	248
New York	1	1			1	1
North Carolina	9	5	3	2	12	7
Oregon	112	91	192	153	304	244
Pennsylvania	1	1			1	1
South Carolina	5	7	1		6	7
South Dakota	11	10	81	41	92	51
Tennessee	3	4			3	4
Texas	6	9			6	9
Utah	191	167	21	12	212	179
Virginia	3	1		1	3	2
Washington	83	61	88	56	171	117
Wyoming	9	8	28	12	37	20
	5,393	4,542	4,176	3,349	9,569	7,891

MINE PRODUCTION

SUMMARY

The following table gives the mine production of gold and silver in 1940 and 1941, by States, in terms of recovered metals, as calculated by the Bureau of Mines from reports from the producing mines. The annual percentage gains in gold production in the years following the 69-percent increase in the price of gold are as follows: 1934 over 1933, 19 percent; 1935 over 1934, 18 percent; 1936 over 1935, 19 percent; 1937 over 1936, 9 percent; 1938 over 1937, 7 percent; 1939 over 1938, 10 percent; 1940 over 1939, 5 percent; but 1941 decreased from 1940, 2 percent. The total gain in 1940 over 1933 was 128 percent. The output of silver decreased 5 percent in 1941 from 1940 but was 194 percent above that in 1933.

Mine production of gold and silver in the United States, 1940–41, by regions and States, in terms of recovered metals

Region and State	Gold					Silver				
	Fine ounces		Increase or decrease (percent)	Value (at $35 an ounce)		Fine ounces		Increase or decrease (percent)	Value (at $0.71111+ an ounce)	
	1940	1941		1940	1941	1940	1941		1940	1941
Western States and Alaska:										
Alaska	755, 970	695, 467	−8	$26, 458, 950	$24, 341, 345	191, 679	191, 522	(1)	$136, 305	$136, 193
Arizona	294, 807	315, 392	+7	10, 318, 245	11, 038, 720	7, 075, 215	7, 498, 260	+6	5, 031, 264	5, 332, 096
California	1, 455, 671	1, 408, 793	−3	50, 948, 485	49, 307, 755	2, 359, 776	2, 154, 188	−9	1, 678, 063	1, 531, 867
Colorado	367, 336	380, 029	+3	12, 856, 760	13, 301, 015	9, 710, 709	7, 301, 697	−25	6, 905, 393	5, 192, 318
Idaho	146, 480	149, 816	+2	5, 126, 800	5, 243, 560	17, 552, 240	16, 672, 410	−5	12, 481, 593	11, 855, 936
Montana	272, 602	246, 475	−10	9, 541, 070	8, 626, 625	12, 361, 050	12, 386, 925	(1)	8, 790, 080	8, 808, 480
Nevada	383, 933	366, 403	−5	13, 437, 655	12, 824, 105	5, 175, 928	5, 830, 238	+13	3, 680, 660	4, 145, 947
New Mexico	35, 943	27, 845	−23	1, 258, 005	974, 575	1, 407, 839	1, 328, 317	−6	1, 001, 130	944, 581
Oregon	113, 402	96, 565	−15	3, 969, 070	3, 379, 775	219, 112	276, 158	+26	155, 813	196, 379
South Dakota	586, 662	600, 637	+2	20, 533, 170	21, 022, 295	175, 514	170, 771	−3	124, 810	121, 437
Texas	312	306	−2	10, 920	10, 710	1, 326, 150	1, 096, 027	−17	943, 040	779, 397
Utah	355, 494	356, 501	(1)	12, 442, 290	12, 477, 535	12, 172, 299	11, 315, 485	−6	8, 655, 857	8, 103, 456
Washington	82, 136	84, 176	+2	2, 874, 760	2, 946, 160	365, 175	402, 030	+10	259, 680	285, 888
Wyoming	740	478	−35	25, 900	16, 730	114	94	−18	81	67
	4, 851, 488	4, 728, 883	−3	169, 802, 080	165, 510, 905	70, 092, 800	66, 704, 122	−5	49, 843, 769	47, 434, 042
Eastern States:										
Alabama	5	30	+500	175	1, 050	3	3		2	2
Georgia	961	311	−68	33, 635	10, 885	630	38	−94	448	27
New York						35, 720	37, 734	+6	25, 401	26, 833
North Carolina	1, 943	3, 244	+67	68, 005	113, 540	6, 480	7, 439	+15	4, 608	5, 290
Pennsylvania	1, 840	2, 422	+32	64, 400	84, 770	13, 064	15, 016	+15	9, 290	10, 678
South Carolina	13, 076	15, 508	+19	457, 660	542, 780	8, 047	6, 525	−19	5, 722	4, 640
Tennessee	173	227	+31	6, 055	7, 945	38, 610	39, 161	+1	27, 456	27, 848
Virginia	458	240	−48	16, 030	8, 400	271	135	−50	193	96
	18, 456	21, 982	+19	645, 960	769, 370	102, 825	106, 051	+3	73, 120	75, 414
Central States										
Illinois						4, 766	20, 340	+327	3, 389	14, 464
Indiana	5		−100	175						
Michigan						88, 657	60, 796	−31	63, 045	43, 233
Missouri						260, 314	367, 688	+41	185, 112	261, 467
	5		−100	175		353, 737	448, 824	+27	251, 546	319, 164
Philippine Islands	[2] 1, 114, 201	[2] 1, 130, 933	+2	38, 997, 035	39, 582, 655	[2] 1, 275, 383	[2] 1, 224, 336	−4	906, 939	870, 639
Puerto Rico	[2] 13	(3)	(3)	455	(3)	[2] 1	(3)	(3)	1	(3)
	1, 114, 214	1, 130, 933	+2	38, 997, 490	39, 582, 655	1, 275, 384	1, 224, 336	−4	906, 940	870, 639
	5, 984, 163	5, 881, 798	−2	209, 445, 705	205, 862, 930	71, 824, 746	68, 483, 333	−5	51, 075, 375	48, 699, 259

[1] Less than 0.5 percent. [2] United States refineries' receipts. [3] Figures for 1941 not available.

Gold and silver, produced in the Western States of the United States, 1848–1941, and in Alaska, 1880–1941, in terms of recovered metals

[Original research, 1848–1903, by Chas. W. Henderson; 1904–41, by western offices, Economics and Statistics Service]

State	Period	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
Alaska	1880–1941	25, 152, 030	$593, 335, 652	19, 562, 668	$13, 915, 671
Arizona	1860–1941	10, 174 289	243, 595, 270	268, 688, 038	199, 881, 769
California	1848–1941	100, 262, 759	2, 211, 300, 217	103, 032, 188	83, 335, 903
Colorado	1858–1941	38, 296, 755	834, 263, 389	717, 950, 564	558, 481, 176
Idaho	1863–1941	7, 629, 158	170, 159, 933	469, 574, 957	322, 200, 087
Montana	1862–1941	16, 680, 518	368, 271, 342	713, 202, 910	521, 196, 672
Nevada	1859–1941	24, 775, 446	545, 702, 286	580, 706, 330	534, 278, 401
New Mexico	1848–1941	2, 148, 780	48, 541, 493	65, 276, 576	51, 150, 206
Oregon	1852–1941	5, 620, 788	124, 690, 623	5, 089, 782	4, 697, 387
South Dakota	1876–1941	20, 037, 943	482, 925, 214	9, 346, 276	6, 648, 628
Texas	1885–1941	8, 041	215, 380	32, 513, 756	22, 874, 293
Utah	1864–1941	9, 058, 229	217, 263, 055	681, 300, 151	496, 755, 268
Washington	1860–1941	1, 881, 725	44, 615, 698	11, 222, 890	7, 941, 147
Wyoming	1867–1941	77, 891	1, 834, 513	74, 580	51, 715
Total, Western States and Alaska	1848–1941	261, 804, 352	5, 886, 714, 065	3, 677, 541, 666	2, 823, 408, 323

ORE PRODUCTION, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

The best index of lode mining is the quantity and metallic content of ore mined rather than the number of mines or operators. The following tables give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that produced gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1941. The individual State chapters from which these tables were compiled contain additional tables and text on the subject and may be found elsewhere in this volume.

The classification originally adopted in 1905 on the basis of smelter terminology, smelter settlement contracts, and smelter recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in recovery of metals and the lowering of grade of complex ores treated, accomplished by improved mill concentration processes. A "dry" ore is one that carries so little lead or copper that by itself in quantity it would not satisfy the requirements for the smelter charge in lead smelting or copper smelting, respectively. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper (or less than this percentage if no other metal is present), or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay (minimum lead smelting charge requires 7.5 to 8.5 percent wet assay) or more of lead, irrespective of precious-metal content; an ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) range from 16 to 45 percent zinc; zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated. The smelter classification applies to concentrates.

Siliceous (silica [4] in excess of iron) gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry and siliceous ores" thus, by elimination, include both dry siliceous and irony, but chiefly siliceous, ores valuable for their gold and silver content, regardless of method of treatment, and dry fluxing ores carrying considerable quantities of iron and manganese oxides, or iron sulfide, and very small quantities of gold and silver. Dry and siliceous gold ores are those that by inspection are overwhelmingly of gold content; a similar qualification applies to silver ores; decision as to "gold-silver" ore is made arbitrarily on a basis of value, using the rule that the metal of lower value is not used in the bimetal classification unless its value is equal to or over one-quarter of the combined value of gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report unless otherwise indicated.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1941 [1]

State	Gold ore			Gold-silver ore			Silver ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	800,804	0 163	0 27	138,611	0.095	3 80	36,375	0.020	12.53
California	3,848,038	.168	.26	117,983	.243	6 24	2,262	.012	8 50
Colorado	1,234,025	.225	33	270,267	.100	2.30	68,471	014	17.53
Idaho	330,354	.190	.74	82,465	.067	3.60	490,691	.001	20 11
Montana	695,481	.201	.56	121,902	.093	5.75	122,684	.042	14.87
Nevada	1,250,607	.164	.41	416,981	.122	5 81	116,335	.043	10.68
New Mexico	18,305	.238	.99	89,430	.130	8 15	282	.028	27 42
Oregon	87,748	.382	1.10	9,779	.264	16.97	4	-----	44.50
South Dakota	1,711,744	.351	.10	---------	-----	-----	---------	-----	-----
Texas	---------	-----	-----	---------	-----	-----	140,739	.002	7.79
Utah	328,576	.128	.40	199,866	.060	4 73	94,208	.041	13 34
Washington	178,121	.211	.98	87	.368	13.98	2,492	.021	4.30
Wyoming	117	.248	.12	---------	-----	-----	---------	-----	-----
Total, Western States	10,483,920	.208	32	1,447,371	.112	4.94	1,074,543	.016	15.80
Alaska	4,480,364	.045	.03	---------	-----	-----	---------	-----	-----
Eastern States	152,833	.125	.06	---------	-----	-----	---------	-----	-----
	15,117,117	.159	.23	1,447,371	.112	4.94	1,074,543	.016	15.80

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.

[4] Except where mineralization approaches a matte, ores in their natural state generally contain more silica than iron and usually are highly siliceous.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1941—Continued

State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States									
Arizona	24,153,483	0.006	0.21	18,432	0.116	7.11	663	0.029	5.65
California	292,232	.041	.62	18,338	.197	9.10	2		83.50
Colorado	207,678	.121	20.74	7,917	.184	9.28	4	1.000	110.50
Idaho	7,979	.087	5.50	212,251	.002	4.92	174	.011	127.74
Montana	3,791,202	.004	1.62	33,029	.152	9.37	4		34.00
Nevada	6,850,444	.010	.04	26,838	.036	25.38			
New Mexico	6,975,682	.001	.03	2,261	.187	3.18			
Oregon	629	.016	3.53						
South Dakota									
Texas	58		.38	21	.095	12.14			
Utah	30,444,402	.008	.08	77,979	.123	12.67	5,276	.008	14.49
Washington	694,565	.066	.29	152		2.37			
Wyoming	42	.048	.71						
Total, Western States	73,418,396	.008	.25	397,218	.059	8.56	6,123	.011	16.85
Alaska	144	.215	.89						
Eastern States	[3] 751,516	[4] .004	[5] .08	469					
	74,170,056	.008	.25	397,687	.059	8.55	6,123	.011	16.85

State	Zinc ore			Zinc-lead, zinc-copper, and zinc-lead-copper ores[6]			Total ore		
Western States									
Arizona	2,143	0.027	6.14	341,283	0.043	3.36	25,491,794	0.012	0.29
California	1,330	.002	.40				4,280,185	.161	.49
Colorado	224	.344	3.38	434,200	.041	1.59	2,222,706	.157	3.28
Idaho	22,551	.017	8.58	1,558,215	.005	3.17	2,704,680	.029	6.16
Montana	[7] 182,745	.001	.11	695,202	.013	4.30	5,642,249	.033	2.19
Nevada	1,488			136,942	.014	5.04	8,799,635	.037	.66
New Mexico	148,359			295,907		1.09	7,530,226	.003	.18
Oregon							98,160	.368	2.70
South Dakota							1,711,744	.351	.10
Texas							140,818	.002	7.78
Utah	2,302	.004	3.50	[8] 800,208	.055	7.13	31,952,817	.011	.36
Washington				363,092		.03	1,238,509	.068	.32
Wyoming							159	.195	.28
Total, Western States	361,142	.002	.65	4,625,049	.021	3.57	91,813,762	.033	.72
Alaska							4,480,508	.046	.03
Eastern States	2,037,653			837,926		.05	[3] 3,780,397	.006	.03
	2,398,795	(9)	.10	5,462,975	.017	3.03	100,074,667	.033	.67

[3] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[4] The quantity from which this average is derived is 2,746 ounces, which includes 2,422 ounces from magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[5] The quantity from which this average is derived is 59,221 ounces, which includes 15,016 ounces from magnetite-pyrite-chalcopyrite ore from Pennsylvania
[6] Includes zinc-copper ore from Arizona and zinc-lead-copper ore from Utah.
[7] Includes 170,592 tons of current slag fumed.
[8] Includes 29,658 tons zinc-lead slag.
[9] Less than 0.0005 ounce per ton.

Mine production of gold in the United States in 1941, by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alabama		30						30
Alaska	491,581	203,855	31					695,467
Arizona	11,931	144,198	142,498	2,129	19	58	14,559	315,392
California	718,013	675,129	12,038	3,611		2		1,408,793
Colorado	30,377	305,194	25,187	1,455	4	77	17,735	380,029
Georgia	189	122						311
Idaho	72,395	68,656	696	426	2	378	7,263	149,816
Montana	61,611	156,585	13,871	5,007		138	9,263	246,475
Nevada	36,897	261,148	65,510	964			1,884	366,403
New Mexico	2,488	15,966	8,908	423			60	27,845
North Carolina	6	3,141	97					3,244
Oregon	60,430	36,125	10					96,565
Pennsylvania			2,422					2,422
South Carolina		15,508						15,508
South Dakota	93	600,544						600,637
Tennessee		227						227
Texas		304		2				306
Utah	629	58,157	243,953	9,602	41	10	44,109	356,501
Virginia	8	232						240
Washington	540	37,593	46,034				9	84,176
Wyoming	447	29	2					478
	1,487,635	2,582,743	561,257	23,619	66	663	94,882	4,750,865

[1] Philippine Islands and Puerto Rico excluded.

Mine production of silver in the United States in 1941, by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alabama		3						3
Alaska	67,544	123,850	128					191,522
Arizona	2,205	1,195,814	5,006,374	130,985	3,745	13,168	1,145,969	7,498,260
California	65,475	1,741,386	179,744	166,879	167	537		2,154,188
Colorado	5,687	2,224,632	4,306,343	73,496	442	756	690,341	7,301,697
Georgia	14	24						38
Idaho	17,408	10,411,202	43,851	1,043,250	22,227	193,484	4,940,988	16,672,410
Illinois							20,340	20,340
Michigan			60,796					60,796
Missouri				367,688				367,688
Montana	10,035	2,915,273	6,142,250	309,341	136	20,481	2,989,409	12,386,925
Nevada	14,033	4,184,776	259,686	681,146			690,597	5,830,238
New Mexico	284	754,230	242,834	7,200			323,769	1,328,317
New York							37,734	37,734
North Carolina	1	2,394	5,044					7,439
Oregon	11,205	262,733	2,220					276,158
Pennsylvania			15,016					15,016
South Carolina		6,525						6,525
South Dakota	7	170,764						170,771
Tennessee			39,161					39,161
Texas		1,095,750	22	255				1,096,027
Utah	90	2,333,078	2,285,377	988,000	76,459	8,046	5,704,435	11,395,485
Virginia		135						135
Washington	90	186,950	202,091	360			12,539	402,030
Wyoming	50	14	30					94
	194,128	27,609,533	18,790,967	3,768,600	103,176	236,472	16,556,121	67,258,997

[1] Philippine Islands and Puerto Rico excluded.

Gold and silver produced in the United States from ore, old tailings, etc., in 1941, by States and by methods of recovery, in terms of recovered metals [1]

State	Total ore old tailings, etc., treated (short tons)	Ore, old tailings, etc., to amalgamation and cyanidation mills and bullion recovered: Ore (short tons)	Old tailings, etc. (short tons)	Gold (fine ounces)	Silver (fine ounces)	Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from amalgamation and cyanidation and concentrating mills combined): Short tons	Gold (fine ounces)	Silver (fine ounces)	Crude ore to smelters: Short tons	Gold (fine ounces)	Silver (fine ounces)
Western States and Alaska:												
Alaska	4, 480, 508	4, 443, 260		165, 530	31, 823	37, 172	5, 683	38, 132	92, 042	76	224	113
Arizona	25, 491, 794	833, 910		78, 515	182, 800	19, 001, 720	1, 028, 852	114, 974	2, 782, 173	5, 656, 164	109, 972	4, 531, 082
California	4, 280, 185	2, 997, 893	845, 067	517, 733	837, 955	392, 406	34, 620	157, 713	961, 339	44, 819	15, 334	289, 419
Colorado	2, 222, 786	1, 244, 184		203, 191	53, 614	730, 982	106, 124	111, 198	2, 404, 131	247, 620	35, 263	4, 838, 265
Idaho	2, 704, 680	179, 503		21, 533	14, 369	2, 492, 641	353, 372	51, 396	16, 091, 846	32, 533	4, 492	548, 787
Montana	5, 642, 249	542, 870		64, 231	169, 095	4, 661, 117	662, 594	60, 046	10, 102, 389	438, 262	60, 587	2, 105, 406
Nevada	8, 799, 635	1, 550, 341	5, 528	210, 927	2, 255, 129	7, 042, 097	326, 080	77, 642	1, 620, 036	201, 669	40, 937	1, 941, 040
New Mexico	7, 530, 226	90, 519		11, 067	690, 466	7, 352, 950	313, 725	10, 757	518, 113	86, 757	3, 533	119, 454
Oregon	98, 160	22, 949	1, 185	5, 027	735	65, 130	6, 375	25, 596	161, 326	8, 896	5, 512	102, 892
South Dakota	1, 711, 744	1, 711, 539		599, 156	168, 860	200	505	1, 290	383	5	98	1, 521
Texas	140, 818	140, 503		285	940, 967		439	19	152, 781	315	2	2, 279
Utah	31, 952, 817	252, 595		17, 839	[illegible]	31, 235, 139	1, 073, 438	286, 575	7, 973, 147	465, 083	51, 458	3, 422, 061
Washington	1, 238, 509	135, 984		7, 359	17, 359	1, 063, 076	71, 871	65, 448	329, 832	39, 449	10, 829	54, 749
Wyoming	159	75		10	4					84	21	40
	96, 294, 270	14, 146, 125	851, 780	1, 902, 403	5, 363, 363	74, 074, 633	3, 983, 678	1, 000, 786	43, 189, 538	7, 221, 732	338, 262	17, 957, 108
Eastern States	[2] 6, 157, 108	151, 471	1, 000	18, 741	9, 004	5, 954, 520	(3)	2, 649	91, 911	70, 117	389	5, 121
	102, 451, 378	14, 297, 596	852, 780	1, 921, 144	5, 372, 367	80, 009, 153	[4] 3, 983, 678	1, 003, 435	43, 281, 449	7, 291, 849	338, 651	17, 962, 229

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes ore containing no gold or silver.
[3] Bureau of Mines not at liberty to publish figures.
[4] Excludes concentrates from Eastern States.

Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1937–41 [1]

Year	Bullion and precipitates recovered (fine ounces)				Percent of gold and silver from all sources [1]							
	Amalgamation		Cyanidation		Amalgamation		Cyanidation		Smelting [2]		Placers	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1937	1,040,593	368,394	793,204	3,039,172	25.3	0.5	19.3	4.3	30.8	95.0	24.6	0.2
1938	984,620	223,058	962,788	4,275,154	23.1	.4	22.6	7.0	26.4	92.4	27.9	.2
1939	985,717	243,786	1,043,675	4,556,336	21.1	.4	22.3	7.1	28.0	92.2	28.6	.3
1940	959,452	248,112	1,044,014	5,251,162	19.7	.3	21.4	7.5	27.9	91.9	31.0	.3
1941	916,113	214,665	1,005,031	5,157,702	19.3	.3	21.1	7.7	28.3	91.7	31.3	.3

[1] Philippine Islands and Puerto Rico excluded. [2] Both crude ores and concentrates.

Gold and silver produced at amalgamation and cyanidation mills in the United States in 1941, by States [1]

State	Amalgamation			Cyanidation			Percent of gold and silver from all sources in State			
	Ore, old tailings, concentrates, etc., treated (short tons)	Bullion recovered (fine ounces)		Ore, old tailings, concentrates, sands, slimes, etc., treated (short tons)	Bullion and precipitates recovered		Amalgamation		Cyanidation	
		Gold	Silver		Gold	Silver	Gold	Silver	Gold	Silver
Alaska	4,442,871	165,322	31,810	389	208	13	23.77	16.61	0.03	0.01
Arizona	7,517	888	297	826,393	77,627	182,503	.28	(2)	24.61	2.43
California	2,104,298	285,038	65,978	2,225,102	232,695	771,977	20.23	3.06	16.52	35.84
Colorado	1,040,093	78,933	18,513	578,261	124,258	35,101	20.77	.25	32.70	.48
Idaho	173,321	20,874	12,883	6,182	659	1,486	13.93	.08	.44	.01
Montana	99,482	7,938	2,508	443,388	56,293	166,587	3.22	.02	22.84	1.34
Nevada	250,702	25,757	19,120	1,425,740	185,170	2,236,009	7.03	.33	50.54	38.35
New Mexico	5,908	986	249	84,611	10,081	690,217	3.54	.02	36.20	51.96
Oregon	1,440	971	222	22,802	4,056	513	1.01	.08	4.20	.19
South Dakota	1,506,183	328,166	62,423	1,704,356	270,990	106,437	54.64	36.55	45.12	62.33
Texas	----	----	----	140,064	285	940,967	----	----	93.14	85.85
Utah	515	35	122	252,080	17,804	65	.01	(2)	4.99	(2)
Washington	694	777	363	135,290	6,582	16,996	.92	.09	7.82	4.23
Wyoming	75	10	4	----	----	----	2.09	4.26	----	----
Eastern States	3,348	418	173	149,123	18,323	8,831	1.90	.16	83.35	8.33
	9,636,447	916,113	214,665	7,993,781	1,005,031	5,157,702	19.28	.32	21.15	7.67

[1] Philippine Islands and Puerto Rico excluded. [2] Less than 0.005 percent.

PLACERS

Dredging.—Placer gold is obtained largely from gravels handled by connected-bucket floating dredges, which recovered approximately 58 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1941 and 60 percent in 1940. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1941 is recorded as 18,385,002 ounces, originating by States as follows: California, 11,255,979 ounces; Alaska, 4,908,196 (including the production from two Becker-Hopkins single-dipper dredges and some gold by hydraulicking); Montana, 659,800; Idaho, 575,660; Colorado, 440,672; Oregon, 445,405; and other States, 99.290. The out-

put in 1941 was 867,005 ounces from 123 dredges, of which California produced 418,282 ounces from 47 dredges; Alaska, 307,087 from 47 dredges; Idaho, 52,358 from 12 dredges; Montana, 33,844 from 7 dredges; Oregon, 24,131 from 7 dredges; and Colorado, 10,622 from 2 dredges.

Connected-bucket floating gold dredges operated in the United States, 1940–41, by companies and districts

ALASKA

Company	Address	District	Number of dredges 1940	Number of dredges 1941
Standard Mines, Inc [1]	Ferry	Bonnifield-Nenana	1	1
Triple X Placers Co.[1]	do	do	1	
Alluvial Golds, Inc	Fairbanks	Circle	1	1
C. J. Berry Dredging Co	Miller House	do	1	1
Gold Placers, Inc	Fairbanks	do	1	1
Alaska Placer Co	Council	Council-Bluff	1	1
Camp Creek Dredging Co	do	do	1	1
Council Dredging Co	do	do	1	1
Inland Dredging Co	do	do	1	1
Ophir Gold Dredging Co	do	do	1	1
Brinker-Johnson Co	Fairbanks	Fairbanks		1
United States Smelting, Refining & Mining Co., Fairbanks Department.	do	do	8	8
Arctic Circle Exploration, Inc	Candle	Fairhaven	2	2
Dry Creek Dredging Co	Deering	do	1	1
Forsgren Dredging Co	do	do	1	1
Boundary Dredging Co	Boundary	Fortymile	1	1
Wade Creek Dredging Co	Fairbanks	do	1	1
Bristol Bay Mining Co	Goodnews Bay	Goodnews Bay	1	1
American Creek Operating Co., Inc	Fairbanks	Hot Springs	1	
North American Dredging Co	Flat	Iditarod	1	1
J. E. Riley Investment Co	do	do	1	1
Ganes Creek Dredging Co	Ophir	Innoko	1	1
Moss & Larson Mining Co	do	do	1	1
W. F. Puntila	do	do	1	
Nels J. Vibe	do	do	1	1
Castleton & Keenan (Kougarok Consolidated Placers, Inc.).	Nome	Kougarok	1	1
Fox Bar Dredging Co	do	do	1	1
Dime Creek Dredging Co	Haycock	Koyuk	1	
Ungalik Syndicate	Nome	do	1	1
American Creek Dredging Co	do	Nome		1
Casa de Paga Gold Co	do	do	1	1
Lee Brothers Dredging Co	Solomon	do	2	2
Osborn Creek Dredging Co	Nome	do	1	1
Tolbert Scott	do	do	1	1
United States Smelting, Refining & Mining Co., Nome Department	do	do	3	4
Bartholomae Oil Corporation	Teller	Port Clarence	1	
Livengood Placers, Inc	Livengood	Tolovana	1	1
Nome Creek Mining Co	Fairbanks	do	1	1
New York Alaska Gold Dredging Co	Nyac	Tuluksak-Aniak	2	2
			49	47

CALIFORNIA

Company	Address	District	1940	1941
Etna Gold Dredging Co	Callahan	Callahan	1	1
Yuba Consolidated Gold Fields	San Francisco	do	1	1
Gold Hill Dredging Co	do	Camanche	2	2
Lancha Plana Gold Dredging Co	Camanche	do	1	
Cosumnes Gold Dredging Co	San Francisco	Cosumnes River	1	1
Capital Dredging Co	do	Folsom	2	2
Lancha Plana Gold Dredging Co	Ione	do	1	1
Natomas Co	Sacramento	do	7	7
French Gulch Dredging Co	San Francisco	French Gulch	1	1
Cal Oro Gold Dredging Co	do	Greenhorn	1	1
Thurman Gold Dredging Co	Redding	Igo	1	1
Arroyo Seco Gold Dredging Co	San Francisco	Ione	1	1
Lancha Plana Gold Dredging Co	Ione	do	1	1
California Gold Dredging Co	San Francisco	Jenny Lind	1	1
Junction City Mining Co	Junction City	Junction City	1	1

[1] Single-dipper dredge.

Connected-bucket floating gold dredges operated in the United States, 1940–41, by companies and districts—Continued

CALIFORNIA—continued

Company	Address	District	Number of dredges 1940	Number of dredges 1941
Yreka Gold Dredging Co	San Francisco	Klamath River	1	1
La Grange Gold Dredging Co	do	La Grange	1	1
Tuolumne Gold Dredging Corporation	do	do	1	1
Yuba Consolidated Gold Fields	do	do		1
C. R. and T. D. Harris	Lewiston	Lewiston	1	
Roseville Gold Dredging Co	San Francisco	Ophir	1	1
Gold Hill Dredging Co	do	Oroville	1	1
Oroville Gold Dredging Co	Oroville	do		1
Yuba Consolidated Gold Fields	San Francisco	do	4	4
Poverty Hill Properties	do	Port Wine		1
Williams Bar Dredging Co	Marysville	Smartville	1	1
Merced Dredging Co	San Francisco	Snelling	1	1
San Joaquin Mining Co	do	do	1	1
Snelling Gold Dredging Co	Snelling	do	2	2
Yuba Consolidated Gold Fields	San Francisco	do	1	1
Carrville Gold Co	Duluth, Minn	Trinity Center	1	1
Yuba Consolidated Gold Fields	San Francisco	Yuba River	6	6
			46	47

COLORADO

Company	Address	District	1940	1941
Timberline Dredging Co	Fairplay	Beaver Creek	1	1
South Platte Dredging Co	do	Park		1
			1	2

IDAHO

Company	Address	District	1940	1941
Fisher-Baumhoff Co	Centerville	Boise Basin	2	2
The Grimes Co	Pioneerville	do	1	
Idaho-Canadian Dredging Co	Idaho City	do	1	1
H. & H. Mines	Elk City	Elk City	1	1
Fisher & Higgins	Salmon	Eureka	1	
Idaho Warren Dredging Co. (dredge operated by Fisher & Higgins in 1940).	North Fork	Gibbonsville		1
Northwest Goldfields	Harvard	Hoodoo	1	1
Boise King Placers	Twin Springs	Middle Boise		1
Mount Vernon Gold Mining Co	Elk City	Orogrande	1	1
Quartz Creek Dredging Co	Pierce	Pierce	1	1
Warren Dredging Co.[1]	Warren	do	2	2
Snake River Mining Co	Sunbeam	Yankee Fork	1	1
			12	12

MONTANA

Company	Address	District	1940	1941
Winston Bros. Co	Helena	Clancey	1	1
Emigrant Dredging Co	Emigrant	Emigrant		1
Star Pointer Exploration Co	Bearmouth	First Chance	1	1
Porter Bros. Corporation	Helena	Helena	1	1
Perry-Schroeder Mining Co	do	Missouri River	1	1
Homer Wilson	Harrison	Norris	1	1
Pioneer Placer Dredging Co	Gold Creek	Pioneer	1	
Gold Creek Mining Co	Deer Lodge	Washington	1	1
			7	7

NEVADA

Company	Address	District	1940	1941
Manhattan Gold Dredging Co	San Francisco	Manhattan	1	1

OREGON

Company	Address	District	1940	1941
Western Dredging Co	San Francisco	Canyon	1	1
Murphy-Murray Dredging Co	Rogue River	Gold Hill	1	1
Pleasant Creek Mining Corporation	do	do	1	1
Porter & Co	Baker	Granite	1	1
Sunshine Mining Co. (Burnt River Division)	Boise	Greenhorn		1
The Sumpter Valley Dredging Co	Portland	Sumpter	1	1
Timms Gold Dredging Co	Galena	Susanville	1	1
			6	7

[1] Warren Dredging Co. sold 1 dredge in August 1941 to W. W. Prather.

Gold produced in the United States by connected-bucket floating dredges, 1937–41, in fine ounces

Year	Dredges	California	Alaska	Other States [1]	Total
1937	105	322,961	255,568	65,614	644,143
1938	115	375,296	278,442	82,686	736,424
1939	114	370,264	304,995	112,472	787,731
1940	122	414,966	354,806	134,377	904,149
1941	123	418,282	307,087	141,636	867,005

[1] Colorado, Idaho, Montana, Nevada, and Oregon.

Other placer-mining methods.—From 1932 through 1941 dragline and power-shovel excavators operated in connection with dry-land and floating amalgamating and sluicing plants have been widely used in placer mining. In 1941 approximately 30 percent of the total output of placer gold, including that of Alaska and excluding that of the Philippine Islands, was recovered at such plants, and 12 percent was produced by old-established mining methods, such as hydraulicking, drift mining, sluicing, and rocking.

Additional information on placer-mining methods may be found in the State reviews in the Minerals Yearbook and Mineral Resources series.

WORLD ASPECTS

WORLD PRODUCTION

According to the Bureau of the Mint, the world output of gold and silver from 1493 to 1940 is 1,375,164,679 fine ounces of gold valued at $31,910,089,774 and 17,244,356,061 fine ounces of silver valued at $15,451,255,865 (see figs. 3 and 4).

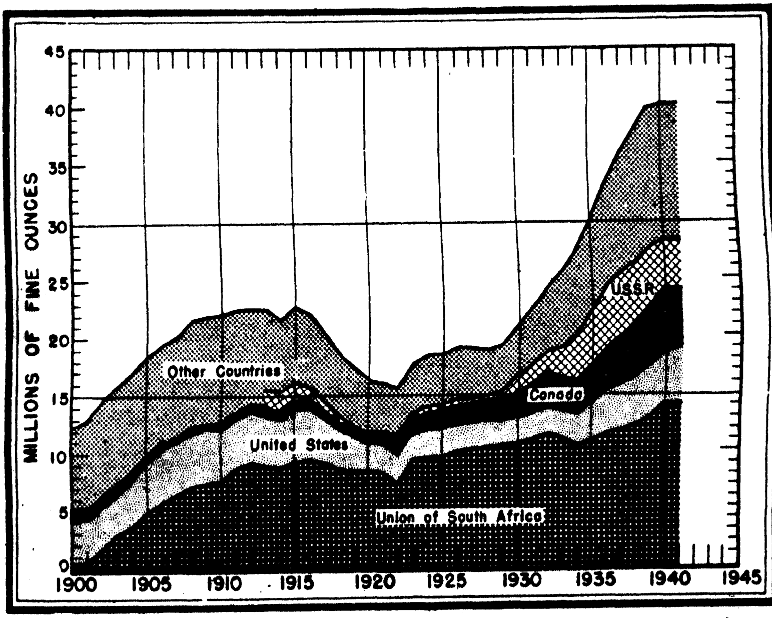

FIGURE 3.—World production of gold, 1900–1941. (Figures for 1941 are preliminary.)

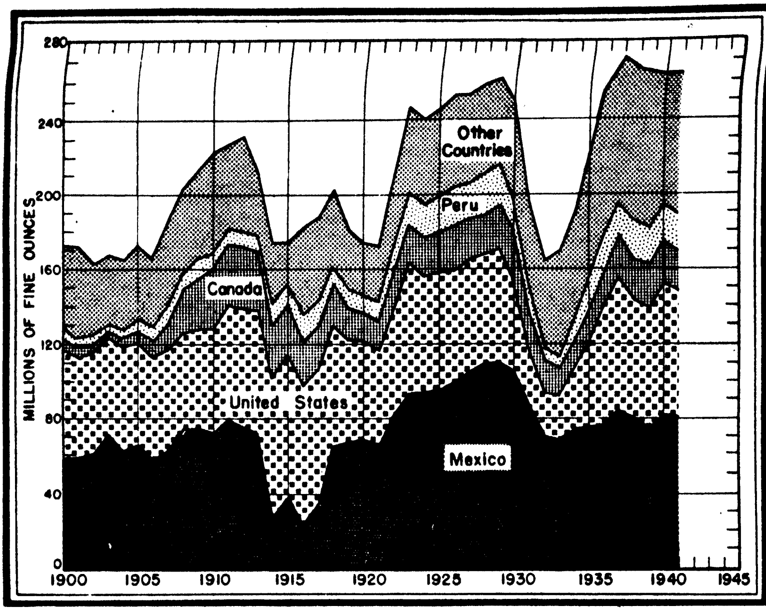

FIGURE 4.—World production of silver, 1900–1941. (Figures for 1941 are preliminary.)

The following tables show the world output of gold and silver from 1937 to 1941.

World production of gold, 1937–41, by countries, in fine ounces [1]

Country	1937	1938	1939	1940	1941
North America:					
United States:					
Continental [2]	4,112,160	4,245,368	4,620,567	4,862,979	4,832,067
Puerto Rico	17	9	35	----------	20
Canada	4,096,213	4,725,117	5,094,379	5,311,145	5,351,689
Central America and West Indies:					
Costa Rica	16,920	17,994	13,261	13,538	[3] 12,760
Cuba	3,707	[4] 3,889	[4] 3,851	[4] 1,251	607
Dominican Republic (exports)	6,710	5,275	6,304	6,914	15,614
Guatemala	4,180	5,466	5,058	4,447	2,560
Honduras	24,170	21,879	22,216	23,173	22,628
Nicaragua	24,242	44,301	100,182	164,355	209,430
Panama	9,023	6,879	3,774	2,634	2,115
Salvador	[5] 15,310	[5] 12,065	[5] 16,424	[5] 51,195	[3] 32,300
Other countries [3]	39,300	48,300	(6)	(6)	(6)
Mexico	846,400	923,819	841,642	883,117	799,975
Newfoundland	22,470	24,246	20,316	21,786	21,194
	9,221,000	10,085,000	10,798,000	11,397,000	11,353,000
South America:					
Argentina	10,449	8,423	12,249	12,860	(6)
Bolivia	[7] 14,251	[7] 9,255	[7] 7,884	[4] 11,749	[4] 8,158
Brazil (lode only)	145,835	148,735	148,355	149,815	147,309
Chile	272,704	294,033	325,052	342,830	264,540
Colombia	442,222	520,717	570,017	631,927	656,019
Ecuador	59,500	74,042	85,352	52,942	70,264
Guiana:					
British	35,993	38,482	38,473	35,745	[3] 30,000
French	47,422	40,638	37,606	40,000	[3] 35,000
Netherlands (Surinam)	12,756	14,154	14,812	15,921	[3] 12,000
Peru	205,350	260,326	272,362	279,606	260,987
Uruguay	----------	657	1,608	1,762	1,364
Venezuela	116,519	114,985	146,608	146,792	145,000
	1,363,000	1,524,000	1,660,000	1,722,000	1,643,000

See footnotes at end of table.

World production of gold, 1937–41, by countries, in fine ounces—Continued

Country	1937	1938	1439	1940	1941
Europe:					
Bulgaria	50	200	6,690	7,330	(6)
Czechoslovakia	9,930	10,000	10,000	[3] 10,000	(6)
Finland	4,822	3,858	4,822	(6)	(6)
France	66,423	87,354	[3] 85,000	(6)	(6)
Germany	8,028	8,650	(6)	(6)	(6)
Austria	140				
Hungary	5,159	5,655	5,079	(6)	(6)
Italy	3,103	5,016	(6)	(6)	(6)
Norway	96	55	(6)	(6)	(6)
Portugal	4,366	6,186	5,948	[3] 10,000	(6)
Rumania	277,043	157,924	211,496	130,760	(6)
Spain	3,135	6,955	[3] 30,000	[3] 15,000	(6)
Sweden	193,226	234,122	216,149	197,995	(6)
Switzerland	964	1,125	1,447	(6)	(6)
U. S. S. R.[5]	5,359,000	5,236,000	(6)	(6)	(6)
United Kingdom	60	2,428	(6)	(6)	(6)
Yugoslavia	87,578	76,318	71,503	[3] 75,000	(6)
	6,023,000	5,844,000	5,665,000	5,523,000	[3] 4,500,000
Asia:					
Burma	1,004	1,209	(9)	(9)	(9)
China	(6)	(6)	(6)	[3] 377,000	(6)
Manchuria[7]	118,829	(6)	(6)	(6)	(6)
Chosen	734,585	948,447	975,000	(6)	(6)
Cyprus	[4] 23,650	[4] 29,245	[4] 16,393	13,621	(6)
India, British	330,744	321,138	[9] 316,504	[9] 289,357	[9] 285,945
Indochina	9,870	8,745	8,070	8,038	(6)
Japan	723,375	[3] 760,000	[3] 836,000	(6)	(6)
Malay States					
Federated	33,828	40,209	40,283	35,689	(6)
Straits Settlements	----------	5	8	6	(6)
Unfederated	519	581	880	479	(6)
Netherlands Indies	55,621	76,443	81,183	89,942	(6)
Philippine Islands	716,967	903,265	1,040,146	1,140,126	1,144,332
Sarawak	19,214	18,520	17,261	12,285	(6)
Taiwan	123,073	145,000	(6)	(6)	(6)
Thailand (Siam)	13,768	13,620	12,711	12,717	(6)
Turkey	514	----------	----------	----------	----------
	3,206,000	3,666,000	3,889,000	3,942,000	3,943,000
Africa:					
Bechuanaland	17,577	19,111	17,219	18,015	14,509
Belgian Congo	419,664	455,264	494,642	168,565	(6)
Ruanda and Urundi	12,925	17,994	29,386	(6)	(6)
Cameroons, French	14,211	15,542	(6)	(6)	(6)
Egypt	1,226	2,162	3,877	7,344	(6)
French Equatorial Africa	21,490	40,028	(6)	(6)	(6)
French West Africa (exports)	128,346	127,220	(6)	(6)	(6)
Gold Coast	559,212	674,927	782,271	866,326	(6)
Kenya Colony	54,774	70,500	77,000	77,243	(6)
Liberia (exports)	2,457	1,902	6,536	9,661	20.370
Madagascar	13,471	13,770	[3] 14,000	11,580	(6)
Morocco, French	4,630	7,491	(6)	(6)	(6)
Nigeria	26,466	24,815	25,794	25,617	(6)
Portuguese East Africa	11,129	9,609	11,064	11,432	(6)
Rhodesia					
Northern	4,228	1,092	4,645	(6)	(6)
Southern	804,219	814,078	795,613	826,485	790,442
Sierra Leone	35,717	30,012	33,657	32,676	(6)
South-West Africa	2,804	1,796	1,619	1,358	304
Sudan	7,388	8,866	7,510	6,606	(6)
Swaziland	2,410	1,246	983	1,080	(6)
Tanganyika	75,281	81,857	130,366	143,693	(6)
Uganda	16,947	20,502	15,115	11,060	(6)
Union of South Africa	11,734,575	12,161,392	12,819,344	14,037,741	14,386,361
Other countries	(6)	(6)	(6)	(6)	(6)
	13,997,000	14,627,000	15,488,000	17,468,000	17,090,000
Oceania:					
Australia:					
New South Wales	68,607	88,707	87,189	89,839	88,001
Northern Territory	11,563	12,378	16,586	22,423	(6)
Queensland	127,281	151,432	147,248	154,011	(6)
South Australia	6,962	5,292	3,930	3,270	(6)
Victoria	145,799	144,243	156,522	163,662	149,768
Western Australia	1,000,647	1,167,791	1,214,238	1,191,481	1,109,313

See footnotes at end of table.

World production of gold, 1937–41, by countries, in fine ounces—Continued

Country	1937	1938	1939	1940	1941
Oceania—Continued.					
Fiji	24,917	92,362	110,000	111,338	(6)
New Guinea	217,152	236,133	246,214	294,794	(6)
New Zealand	168,487	152,050	178,955	185,665	(6)
Papua	22,153	33,249	28,164	35,000	(6)
Tasmania	20,276	22,200	19,984	21,390	(6)
	1,814,000	2,106,000	2,209,000	2,273,000	2,135,000
	35,624,000	37,852,000	39,709,000	42,325,000	40,664,000

[1] Preliminary world gold production table prepared with revisions and adjustments by B. B. Waldbauer, Foreign Minerals Division, and Frederick Betz, Metal Economics Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint. Figures used were derived in part from the Statistical Yearbook of the League of Nations and from the American Bureau of Metal Statistics. No official statistics are issued by Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable. In some countries accurate figures are not possible to obtain, due to clandestine trade in gold.

[2] Refinery production.

[3] Approximate production.

[4] Exports.

[5] Imports into United States.

[6] Data not available. Estimate included in total.

[7] Purchases by the State Central Bank.

[8] Conjectural figure published by the American Bureau of Metal Statistics (New York), Annual Issue.

[9] Beginning with 1939, Burmese production included with British India.

World production of silver, 1937–41, by countries, in fine ounces [1]

Country	1937	1938	1939	1940	1941
North America:					
United States [2]	71,298,930	61,688,834	63,871,972	68,286,535	71,075,932
Canada	22,977,751	22,219,195	23,163,629	23,833,752	21,754,798
Central America and West Indies:					
Honduras	3,210,337	3,335,070	4,118,864	3,899,164	3,488,677
Other countries [3]	390,000	965,000	681,000	(4)	(4)
Mexico	84,680,875	81,018,809	75,870,575	82,640,074	78,363,961
Newfoundland	1,447,637	1,663,623	1,421,060	1,494,066	1,657,342
	184,006,000	170,891,000	169,127,000	180,754,000	175,941,000
South America:					
Argentina	2,122,000	2,636,361	3,125,756	3,242,200	3,978,400
Bolivia (exports)	9,454,022	6,373,660	7,241,312	5,626,380	7,348,695
Brazil	25,238	25,585	27,075	24,694	21,170
Chile	1,854,649	1,375,530	1,180,902	1,515,563	1,262,000
Colombia	167,971	192,880	242,628	260,310	271,115
Ecuador	98,500	89,111	103,331	105,000	116,836
Guiana, British	4,740	5,060	(4)	(4)	(4)
Peru	17,453,331	20,552,816	18,802,075	19,916,774	15,101,300
	31,180,000	31,251,000	30,728,000	30,696,000	28,105,000
Europe:					
Bulgaria (estimated)	6,500	13,000	(4)	(4)	(4)
Czechoslovakia	1,103,444	1,190,326	(4)	(4)	(4)
Finland	57,900	57,900	61,000	(4)	(4)
France	563,860	[3] 565,000	[3] 565,000	(4)	(4)
Germany	6,774,161	} 7,010,000	(4)	(4)	(4)
Austria	9,774				
Greece [3]	375,000	335,000	(4)	(4)	(4)
Hungary	50,965	46,632	51,600	(4)	(4)
Italy	715,000	812,481	880,000	(4)	(4)
Norway	282,904	250,776	295,787	(4)	(4)
Poland	64,237	62,244	(4)	(4)	(4)
Portugal	11,337	16,742	(4)	(4)	(4)
Rumania	670,214	819,876	712,731	500,204	(4)
Spain	633,177	237,658	(4)	(4)	(4)
Sweden	946,261	1,123,861	1,122,865	745,894	(4)
U. S. S. R.[3]	7,230,000	8,022,000	(4)	(4)	(4)
United Kingdom	71,448	107,985	70,818	(4)	(4)
Yugoslavia	2,242,546	2,524,123	2,293,634	(4)	(4)
	21,809,000	23,196,000	21,978,000	[3] 20,000,000	(4)

See footnotes at end of table.

World production of silver, 1937-41, by countries, in fine ounces—Continued

Country	1937	1938	1939	1940	1941
Asia:					
Burma	6,180,000	5,920,000	6,175,000	([4])	([4])
China	[5] 150,000	([4])	([4])	([4])	([4])
Chosen	2,672,978	([4])	([4])	([4])	([4])
Cyprus	[6] 132,968	[6] 199,719	[6] 103,953	58,341	([4])
Federated Malay States	3,000	3,500	([4])	([4])	([4])
Hong Kong	-------	111,070	([4])	([4])	([4])
India, British	[2] 24,642	22,295	22,745	([4])	([4])
Indochina	3,537	2,411	1,672	1,736	([4])
Japan	[3] 9,902,000	[3] 10,100,000	([4])	([4])	([4])
Netherlands Indies	500,095	579,297	618,028	1,499,544	([4])
Philippine Islands	719,771	1,167,612	1,350,099	1,299,199	1,260,097
Sarawak	-------	1,660	700	([4])	([4])
Taiwan	([4])	([4])	([4])	([4])	([4])
Turkey [7]	380,000	350,000	575,000	575,000	([4])
	20,684,000	21,623,000	23,115,000	22,878,000	([4])
Africa:					
Algeria	72,177	[7] 90,000	[7] 85,000	([4])	([4])
Bechuanaland	1,499	1,127	813	1,207	949
Belgian Congo	2,961,855	3,121,559	2,800,000	3,536,582	([4])
Gold Coast	19,000	23,000	([4])	([4])	([4])
Kenya Colony	7,549	11,200	[3] 12,000	13,626	([4])
Morocco, French	241,549	208,980	([4])	([4])	([4])
Nigeria	102,120	([4])	([4])	([4])	([4])
Portuguese East Africa	1,474	1,808	2,319	1,901	([4])
Rhodesia:					
Northern	83,861	88,237	80,137	([4])	([4])
Southern	152,038	166,417	173,556	186,080	170,364
Sierra Leone	1,568	1,271	([4])	([4])	([4])
South-West Africa	[8] 385,500	[8] 673,500	587,000	[7] 460,000	([4])
Tanganyika	11,696	16,473	27,999	35,492	([4])
Tunisia	58,354	61,149	([4])	([4])	([4])
Uganda	1,379	1,981	1,376	1,015	([4])
Union of South Africa	1,100,641	1,135,374	1,182,516	1,292,284	[7] 1,461,000
	5,202,000	5,652,000	5,389,000	6,130,000	([4])
Oceania:					
Australia:					
New South Wales	9,780,499	9,558,550	8,584,719	[7] 9,000,000	([4])
Queensland	3,264,994	3,533,490	3,885,963	[7] 3,450,000	([4])
South Australia	955	503	541	([4])	([4])
Victoria	5,443	5,808	6,285	([4])	([4])
Western Australia	180,562	271,346	287,439	274,741	[7] 255,000
Fiji	3,463	12,380	([4])	23,020	([4])
New Guinea	[8] 96,000	[8] 104,000	[7] 175,015	199,084	[7] 125,000
New Zealand	443,981	357,709	390,342	415,330	[7] 400,000
Tasmania	1,060,785	1,219,550	1,278,116	1,242,000	([4])
	14,837,000	15,063,000	14,620,000	14,613,000	([4])
	277,718,000	267,676,000	264,957,000	275,071,000	[9] 267,000,000

[1] Preliminary world silver production table prepared with revisions and adjustments by B. B. Waldbauer, Foreign Minerals Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint. No official statistics are issued by Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable.
[2] Philippine Islands excluded.
[3] Approximate production
[4] Data not available. Estimate included in total.
[5] Conjectural figure published by the American Bureau of Metal Statistics.
[6] Exports.
[7] American Bureau of Metal Statistics (New York), Annual Issue.
[8] Imperial Institute (London), Statistical Summary.
[9] Conjectural world total in "Silver in 1941," by E. Baliol Scott: Mining Jour., April 11, 1942, p. 5.

REVIEW BY COUNTRIES

Because of lack of communications between the United States and the countries dominated by the Axis Powers and the censorship imposed by some of the other countries, it has been impossible to obtain information on gold and silver mining in these countries. Few data have come even from some of the countries in the Western Hemisphere. The following summary covers the Philippines and those

countries of the Western Hemisphere from which information has been obtained.

PHILIPPINE ISLANDS

Gold production in the Philippine Islands during 1941 according to mint returns continued to gain as it has each year since 1927, reaching an all-time high of 1,144,332 fine ounces valued at $40,051,600. This represents an increase of 4,206 fine ounces, or 0.4 percent, over 1940, the previous record year. The total value of gold output from 1907 to 1941, inclusive, is computed at $270,540,406.

Silver production, on the other hand, declined in 1941 from 1940, decreasing 39,102 fine ounces, or 3 percent.

The following historical review and description of the gold mines and districts in the Philippine Islands has been prepared by Charles White Merrill.[6]

Since 1936, when Philippine Islands gold production passed that of South Dakota and Alaska, California has been the only political subdivision under the United States flag with a larger output. With the opening of hostilities between the United States and Japan December 7, 1941, however, the Islands' gold-mining industry was suspended almost immediately.

Gold mining in the Philippine Islands antedates written history. Much evidence of widespread mining activities during the Spanish colonial period remains, but production never reached great size. With occupation and pacification of the Islands by the United States, American prospecting techniques were applied, and many promising districts were discovered or rediscovered. Nevertheless, for over 30 years development of gold-mining enterprises was very slow. Even as late as 1931 the value of mine output was only $3,762,433, or less than 10 percent of the value of output in 1940 (1,114,201 fine ounces valued at $38,997,035).

The rapid rise of the industry after 1931 may have been accelerated by the belief that Philippine independence or Japanese conquest would make exploitation less profitable or impossible. Conditions at leading producing properties just before the Japanese invasion, however, gave ample evidence that the very rapid expansion had not created an unhealthy condition in the industry.

Principal mines.—Figure 5 shows the location of the principal mining districts in the Islands. The Baguio district in northern Luzon is the oldest and by far the most important. Also on Luzon is the Paracale district. The most productive mineral area on Mindanao Island is the Surigao district, and on Masbate Island the Masbate district is the leading mining area; the map locates the principal companies operating in the several districts. Three groups of companies, generally referred to by the names of the men holding controlling interests—the Haussermann group, Soriano group, and Marsman group—produced nine-tenths of the Philippine gold in 1940. The following paragraphs summarize the last complete details on the producing companies.

Modern mining in the Philippine Islands can be said to date from June 24, 1903, when the Benguet Consolidated Mining Co. was incorporated; in 1914 John W. Haussermann was placed in charge, and

[6] Many data have been excerpted from the Philippine Mining Yearbook for 1940: Chamber of Mines of the Philippines, 1941.

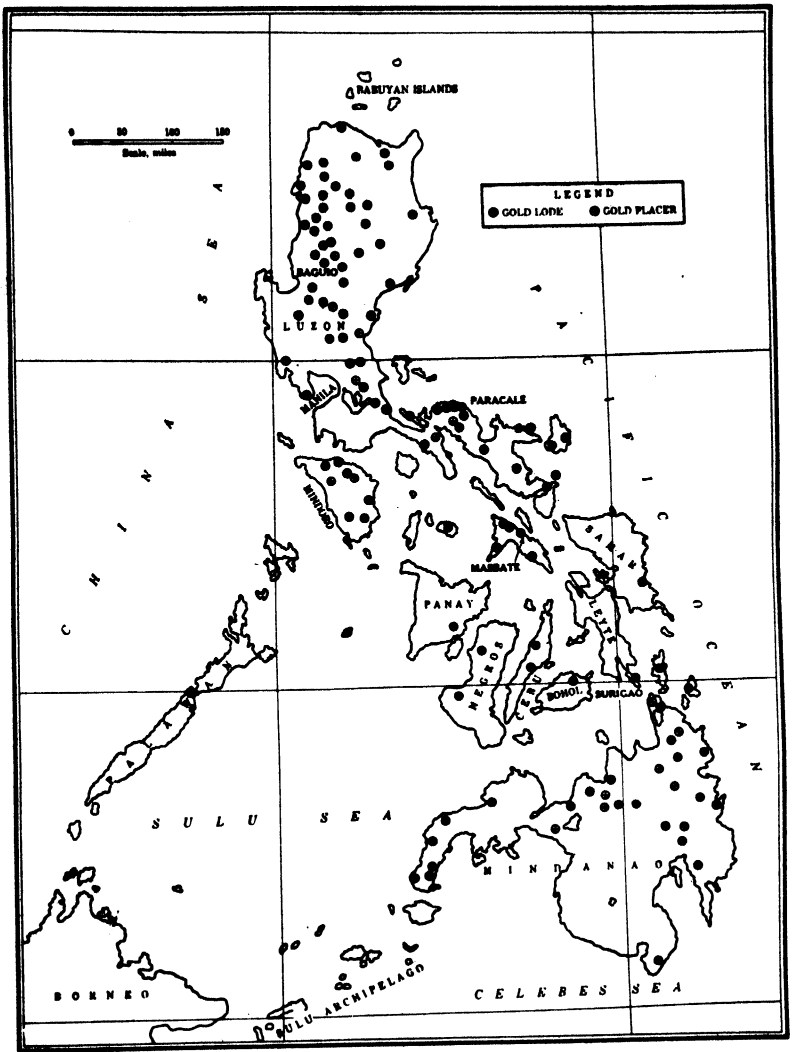

FIGURE 5.—Principal mining districts in the Philippine Islands.

in 1915 the first of a long series of dividends was paid. In 1940 the company produced 154,922 fine ounces of gold and 102,738 fine ounces of silver from 467,130 tons of ore mined in the Baguio district; the ore was treated in the company 1,250-ton cyanide plant. Positive ore reserves January 1, 1941, assured 1 year's operation, and probable ore, 2 additional years. Dividends for 1940 were $3,900,000.

The Balatoc Mining Co.,[6] another member of the Haussermann group of companies, is also situated in the Baguio district. In 1940, when 187,282 ounces of gold and 165,321 ounces of silver were recovered from 738,716 tons of ore, it was the leading gold producer of the Islands; the ore was treated in a 2,000-ton flotation-cyanidation

[6] *See also* Hezzelwood, George W., Development of Mining Methods at Balatoc Mine: Min. Technol., Am. Inst. Min. and Met. Eng., vol. 6, No. 1, January 1942, pp. 1-27.

plant. Positive ore reserves January 1, 1941, assured 2 years' operation and probable ore an additional 1½ years. Dividends in 1940 totaled $2,100,000.

The Cal Horr Mine, a Haussermann company, operated the Cal Horr and Ukab mines in the Baguio district. In 1940, the two properties produced 85,162 tons of ore from which 20,356 ounces of gold and 13,600 ounces of silver were recovered in the company 250-ton cyanide mill. Proved ore reserves were small.

The Ipo Gold Mines, Inc., was the only company in the Haussermann group to prove unprofitable in 1940; limited ore reserves indicated a short life for the enterprise. In 1940, 71,145 tons of ore treated in the company 200-ton all-slime cyanide mill yielded 9,907 ounces of gold and 8,419 ounces of silver.

The Marsman group of mining companies included Coco Grove, Inc., Itogon Mining Co., Philippine Smelting Co., San Mauricio Mining Co., Suyoc Consolidated Mining Co., and United Paracale Mining Co. Coco Grove, Inc.,[7] Paracale district, operated two connected-bucket dredges, each with a capacity of 165,000 cubic yards a month, and in 1940 washed 3,897,357 cubic yards of gravel which yielded 23,045 ounces of gold and 3,517 ounces of silver; these figures represent 85 percent of the gravel washed and 82 percent of the placer gold recovered in the Philippine Islands. On January 1, 1941, reserves were 14,320,000 cubic yards of gravel valued at $3,007,200. Production by Coco Grove, Inc., in 1938 revived the Paracale district placers, which already had a record of $9,000,000 of placer gold from dredging carried on between 1915 and 1922.

The Itogon Mining Co. worked its mine in the Baguio district and treated 327,062 tons of ore in a 1,000-ton all-slime cyanide mill in 1940; 75,996 ounces of gold and 33,401 ounces of silver were recovered. Ore reserves January 1, 1941, were 563,100 tons with a gross value of $4,817,820. In 1940, $500,000 was paid in dividends.

The San Mauricio Mining Co. worked a mine in the Paracale district discovered in 1629 by Diego de Espina; refractory ore was treated in the company 550-ton amalgamation-flotation mill. In 1940, the treatment of 182,716 tons of ore yielded 80,790 ounces of gold and 122,317 ounces of silver; the concentrates contained substantial quantities of lead and copper. Reserves January 1, 1941, assured ore for 2½ years' operation. Dividends paid in 1940 totaled $700,000.

The Suyoc Consolidated Mining Co. operated in the Suyoc district in northern Luzon Island. During 1940, 79,152 tons of ore were treated in the company 350-ton flotation-cyanidation mill and yielded 28,654 ounces of gold and 13,610 ounces of silver. The ore reserves January 1, 1941, were adequate for 3 years' operation at the 1940 rate. Dividends paid in 1940 totaled $98,750.

The United Paracale Mining Co. operated four mines in the Paracale district; 47,293 ounces of gold and 116,255 ounces of silver were recovered from 126,321 tons of ore treated in a 370-ton mill. Ore reserves January 1, 1941, were sufficient to maintain the 1940 production rate for 2 years. Dividends paid in 1940 totaled $130,000.

The Soriano group of properties included the Antamok Goldfields Mining Co., Batong Buhay Gold Mines, Inc., I. X. L. Mining Co., Masbate Consolidated Mining Co., North Camarines Gold Mining

[7] *See also* Johnson, G. R., Coco Grove Dredges Have Interesting Features: Eng. and Min. Jour., vol. 143, No. 4, April 1942, pp. 59–61.

Co., Paracale Gold Mining Co., and Paracale National Gold Mining Co. The Antamok Goldfields Mining Co. (Baguio district) treated 193,966 tons of ore in an 800-ton cyanide plant and recovered 37,112 ounces of gold and 16,136 ounces of silver in 1940. Dividends paid in 1940 totaled $137,500; ore reserves were small.

The I. X. L. Mining Co. worked a group of claims in the Masbate district; 144,868 tons of ore treated in the company 400-ton mill yielded 38,618 ounces of gold and 267,170 ounces of silver. The company was the largest silver producer in the Islands. Ore reserves January 1, 1941, were sufficient for almost 2 years' operation at the 1940 rate. Dividends paid in 1940 totaled $600,000.

The Masbate Consolidated Mining Co., Masbate district, increased the capacity of its 3,000-ton cyanide mill to 3,800 tons in 1941 by adding a colloidal-slime-treatment plant. Before the increase in capacity the mill, which treated 1,078,573 tons of ore (24 percent of the gold ore milled in 1940) and recovered 90,080 ounces of gold and 62,551 ounces of silver, already had the largest capacity in the Philippines. Despite the rapid rate of mining, the reserves January 1, 1941, were sufficient for over 6 years' production at the 1940 rate. Dividends paid in 1940 totaled $500,000. The Masbate Consolidated Mining Co. includes in its holdings the property from which the Colorado Mining Co. is credited with recovering $6,000,000 of gold from 600,000 tons of ore between 1911 and 1925 and the property from which the Syndicate Mining Co. is credited with recovering $6,500,000 from 800,000 tons of ore between 1914 and 1935. The gold-mining operation under the present management is the oldest continuous one in the Philippine Islands.

The North Camarines Gold Mining Co. operated in the Paracale district in 1940; 63,944 tons of ore treated in the company 400-ton amalgamation-cyanidation-flotation mill yielded 19,967 ounces of gold and 24,343 ounces of silver. Ore reserves were small; no dividends were paid in 1940. The outputs of the Batong Buhay Gold Mines, Inc., the Paracale National Gold Mining Co., and the Paracale Gold Mining Co. were much smaller than those of the other Soriano companies.

The larger gold producers not associated with one of the three leading management companies were: Baguio Gold Mining Co., Big Wedge Mining Co., Baguio district; Capsay Mining Co., Masbate district; Mindanao Mother Lode Mines, Inc., and Surigao Consolidated Mining Co., Inc., Surigao district; and Treasure Island Mining Co. on Lahuy Island.

During 1940, the Baguio Gold Mining Co. recovered 31,325 ounces of gold and 21,576 ounces of silver from 142,545 tons of ore treated in the company 400-ton all-slime cyanide plant. Ore reserves January 1, 1941, were equal to 1½ years' production at the 1940 rate. Dividends paid in 1940 totaled $194,985. The Big Wedge Mining Co. recovered 27,726 ounces of gold and 25,057 ounces of silver from 75,642 tons of ore treated in the company 225-ton cyanidation-flotation mill. Dividends paid in 1940 totaled $155,538. Ore reserves were adequate to assure 4 years' operation at the 1940 rate. The Capsay Mining Co. recovered 14,888 ounces of gold and 11,585 ounces of silver from 43,183 tons of gold ore treated in the company 150-ton amalgamation-cyanidation plant. On January 1, 1941, enough ore was blocked out to assure operation at the 1940 rate for 1 year. No dividends were paid in 1940. The Mindanao Mother Lode Mines,

Inc., recovered 31,063 ounces of gold and 43,683 ounces of silver from 68,487 tons of ore treated in the company 200-ton flotation-cyanidation mill during 1940 and paid dividends totaling $200,000. Ore reserves January 1, 1941, sufficed to assure 1½ years' operation at the 1940 rate. Very favorable developments at this property during 1941 resulted in the monthly production rate approaching 12,000 ounces of gold late in 1941. The Surigao Consolidated Mining Co. recovered 30,898 ounces of gold and 40,470 ounces of silver from 117,012 tons of ore treated in the company 325-ton flotation-cyanidation mill. Dividends paid in 1940 totaled $204,680. Ore reserves January 1, 1941, were equal to 4 years' production at the 1940 rate. The Treasure Island Mining Co. treated 57,843 tons of ore in a 200-ton cyanidation mill and recovered 21,918 ounces of gold and 4,759 ounces of silver. No dividends were paid in 1940. The ore reserves January 1, 1941, approximated 1 year's production at the 1940 rate.

Japanese invasion.—The position of the Philippine Islands exposed them to almost immediate attack by Japan; enemy reconnaissance planes were over the Islands almost simultaneously with the bombing of Pearl Harbor, December 7, 1941 (about 4 a. m., December 8, in the Philippines). First landings of Japanese troops were reported at Aparri, Luzon Island, December 10. By December 13, enemy landing parties were established at Aparri, Vigan, Lingayen, and Legaspi, all on the Island of Luzon. The Japanese had landed in force at Davao on Mindanao Island by December 20; 80 transports were sighted December 22 off Lingayen Gulf, northwest Luzon, and the major invasion drive began. On December 26, American forces began their withdrawal from Manila, where virtually all mining companies in the Philippine Islands maintained their main offices, and military authorities declared it an "open" city. By January 4, 1942, organized American and Filipino resistance was confined to Bataan Peninsula and the Corregidor group of fortresses. Bataan fell April 9, and Corregidor capitulated May 6. The Japanese continued their subjugation of isolated guerilla bands.

Although reports from managements of gold mines in the Philippine Islands have been fragmentary, all companies appear to have prepared for complete suspension of operations as soon as war was declared. Underground machinery, including pumps, was removed for storage at the surface. Some expendable supplies, such as fuel oil and explosives, seem to have been requisitioned by the military authorities, and other such supplies were destroyed. Structures, equipment, and machinery at the properties apparently were left undamaged, except for Diesel-power units, which, at least at most properties, were reported destroyed. As Diesel engines have been the gold industry's sole source of power (except for a very small hydroelectric installation at the Benguet Consolidated Mining Co. property), the Japanese will find it impossible to resume production without providing a source of power. It is thought no attempts were made to delay entry into the mines by blasting entries, but removal of the pumps assured that most productive workings would rapidly fill with water. As the mines are situated in nonagricultural areas, it is presumed that the workers dispersed to the lowlands almost immediately. One company is reported to have provided each employee with a dismissal bonus equal to 3 months' wages. As large-scale mining was a very new industry in the Philippine Islands, most of the workers had experience in other occupations, prin-

cipally farming, and it is believed that most gold-mine employees returned to them. The mining staffs, made up largely of Americans, were ordered to Manila, where it was hoped that the open-city declaration of the military authorities would insure their safety.

The invasion progressed so rapidly that little time was given the company managements to consider courses of action; the eventual complete defeat of the Japanese seems to have been assumed. During the occupation, however, a number of possibilities presented themselves, which included reopening of the mines by the Japanese, stripping the properties of machinery either for use elsewhere or as a source of scrap metal, or complete quiescence at the properties.

Some of company officials have stated that the first possibility would be the least injurious to the interests of the mine owners; reserves, being in narrow veins at most of the mines, could not be extracted very rapidly, and operation would tend to preserve the plants and organizations during hostilities. The Japanese need for gold, particularly to foster treason on the Asiatic mainland, has been suggested as an outstanding reason for reopening the gold mines. It seemed not impossible that some method would be found to exact reparations for the benefit of the owners. Possibility that plants would be looted for machinery and scrap was evident, because much of the equipment could be very helpful to the invaders for use elsewhere and because of chronic shortage of metallic scrap in Japan. When the Japanese established complete control of Manila Bay, it became practicable for them to export even the largest units of machinery from the deep-water docks of Manila; whereas, while the American forces at Corregidor commanded the entrance to the bay, there were no Luzon harbors in the hands of the Japanese from which cargoes could be transferred to ocean-going vessels except with lighters. Nothing short of overwhelming military force could have brought the expanding Philippine mining industry to such a sudden halt; the healthy condition of the gold industry at the time of the invasion, however, gives promise of prompt revival when peace is restored.

DOMINION OF CANADA AND NEWFOUNDLAND

Canada.—Gold production in Canada reached a record total of 5,351,689 fine ounces valued at $206,040,026 in 1941 compared with 5,311,145 fine ounces valued at $204,479,083 in 1940. Canada contributes about 12 percent of the total world production of gold and is exceeded only by South Africa and Russia as a world producer.

Canadian production of gold in 1941 was distributed among the various provinces as follows:

	Fine ounces		*Fine ounces*
Ontario	3, 190, 786	Northwest Territories	77, 334
Quebec	1, 088, 860	Yukon	70, 959
British Columbia	615, 838	Nova Scotia	19, 170
Manitoba	150, 523	Alberta	215
Saskatchewan	138, 004		

In Ontario virtually all the gold comes from quartz veins; a small amount is obtained as a byproduct in the refining of nickel and copper. The principal producing areas are Porcupine and Kirkland Lake. The 72 mills with an operating capacity of 36,800 tons a day were in continuous operation in 1941.

In Quebec, also, most of the gold comes from quartz veins, although the largest single producer is the Noranda gold-copper mine. In 1941

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the Province had 24 mills in continuous operation, with a daily capacity of 13,850 tons.

In British Columbia the chief source of gold is gold-quartz mines. Next in importance are the gold-bearing base-metal ores; a relatively small amount is obtained from placer operations. During 1941, 30 mills with a total daily capacity of 5,300 tons were in operation.

Manitoba produces about 55 percent of its total gold from gold-quartz ores and 45 percent from copper-zinc-gold ores. There were five mills operating in 1941; the total capacity was 5,025 tons a day.

In Saskatchewan the production is mainly from that portion of the Flin Flon copper-zinc-gold mine lying within the Province. One mill with a capacity of 1,500 tons a day was in operation in 1941.

Production of gold was begun in the Northwest Territories in 1938 and is obtained from the Yellowknife River and adjoining areas north of Great Slave Lake. Five mills operated in 1941 with a daily capacity of 535 tons. Three of the mills were new.

Yukon's gold output comes almost entirely from placers and is won chiefly from large-scale dredging operations in the vicinity of Dawson City, Klondike district.

Nova Scotia's output is from gold-quartz mines and Alberta's from placer operations. Nova Scotia had two mills in operation, one of which closed late in 1941.

Silver produced in Canada totaled 21,754,798 fine ounces valued at $8,323,603 in 1941 compared with 23,833,752 fine ounces valued at $9,116,172 in 1940. Production is obtained mainly as a byproduct from the treatment of base-metal ores. A substantial amount is also produced from gold-quartz ores and from silver ores; a small amount comes from gold placers.

British Columbia produces nearly half of Canada's silver. The leading silver producer in the Dominion is the Sullivan lead-zinc-silver mine at Kimberley, B. C.

Production of silver in the Cobalt and Sudbury areas in Ontario is important, although production from the Cobalt area has been declining for several years. On the other hand, production from the nickel-copper mines of the Sudbury area has increased. Preliminary figures on the yield in 1941 are 4,981,751 ounces.

Western Quebec has increased its production of silver in recent years owing to rapid development of copper-gold ores, copper-pyrite ores, and gold-quartz ores. Production from Quebec amounted to 1,656,527 ounces in 1941.

Silver production in Manitoba and Saskatchewan comes mainly from the copper-zinc ores of the Flin Flon mine and from a number of smaller properties. The 1941 output from Manitoba is given at 966,102 ounces (preliminary) and from Saskatchewan 2,054,731 ounces (preliminary).

In Yukon silver is produced from silver-lead ores and from gold placers. The 1941 output is given as 1,195,582 ounces (preliminary).

In the Northwest Territories the radium ores in the Great Bear Lake district and the gold ores from several districts produce appreciable quantities of silver. Production from this Province in 1941 was 15,189 ounces. Output in Nova Scotia is small, amounting to 614 ounces (estimated) in 1941.

Newfoundland.—Gold and silver production in Newfoundland depends wholly on the operations of the Buchans Mining Co. at

its lead-zinc-copper mine at Buchans. Output is given at 21,194 ounces of gold and 1,657,342 ounces of silver in 1941, compared with 21,786 ounces of gold and 1,494,066 ounces of silver in 1940.

MEXICO

The Republic of Mexico ranks first among the silver-producing nations of the world. In 1941 Mexico produced 78,363,961 fine ounces, exceeding the United States by more than 7,000,000 ounces and contributing nearly 30 percent of the total world production. Output in 1941 was some 4,000,000 ounces less than in 1940, when 82,640,074 ounces were produced.

The bulk of Mexico's silver comes from the belt of highlands extending southeasterly from Arizona and New Mexico toward Mexico, D. F.; production south of the latitude of Mexico, D. F., is much less important.

Hidalgo was the leading State in silver production in 1941 with a total of 874,111 kg. The mines in the Pachuca district, world-renowned for many years, supplied most of the production. These silver mines are the greatest in Mexico.

Chihuahua ranked next to Hidalgo, with a production of 410,367 kg. in 1941. The most important districts center around Chihuahua and San Francisco del Oro in the central part of the State and around Parral and Santa Bárbara in the southern part.

Zacatecas followed Chihuahua closely in 1941, with 398,771 kg. of silver. About 70 percent of this came from the Fresnillo district in the central part of the State. The next most important district was the Mazapil, in the northeastern part of the State.

The three States, Hidalgo, Chihuahua, and Zacatecas, produced 70 percent of Mexico's silver in 1941. No other State reached the 200,000-kg. mark. San Luis Potosí approached this amount with 186,067 kg.; there are large mines near Charcas, Matehuala, and La Paz. Michoacán produced 158,872 kg., most of which came from the large mine of the American Smelting & Refining Co., at Angangueo. Durango produced 124,281 kg.; the most important district is the San Dimas.

The remaining production of about 250,000 kg. came from a number of other States; Guanajuato and Guerrero together produced about half.

Mexico has never been an outstanding gold producer among the countries of the world. In 1941 the Republic produced 24,882 kg. (799,975 fine ounces). The gold deposits are closely associated with the silver deposits. The six leading States, in the order named, were Hidalgo, Chihuahua, Durango, Michoacán, Zacatecas, and Guanajuato.

WEST INDIES AND CENTRAL AMERICA

Puerto Rico.[8]—Gold and silver mining in Puerto Rico is but little developed. This condition is due to general apathy of Puerto Rican capital toward mining and to the lack of trained mining labor, of roads in many sections of the country, and of plants for treating the ore.

[8] Brief abstract from an article by Ray, Horatio C., Gold Deposits of Puerto Rico Rocks and Minerals, vol. 16, November 1941, pp. 404-405.

Both placer and lode deposits are known on the island, and some development work has been done on them. Nearly all the streams coming from the volcanic backbone of the island carry placer gold, but the amount of gold-bearing gravel is small. Most of the placers are in the general vicinity of Barranquitas-Naranjito-Corozal, Luquillo Forest Reserve, and San German.

Lode deposits have been prospected near Barranquitas, Corozal, and San German and the Carmen township of Guayama. Some of these deposits are considered to have commercial possibilities if systematic development were made and mills were built to concentrate the ore.

Cuba.—Two mines have produced gold or silver in Cuba during the last 10 years. The Delita mine on the Isle of Pines operated for a time in 1937 and produced 1,311 ounces of gold and 2,255 ounces of silver. The Nerva Potosí mine in the Province of Oriente operated regularly in 1941; in 1940 it produced 2,857 ounces of gold.

Dominican Republic.—Production of gold in the Dominican Republic amounted to 636 kg. valued at $546,476 in 1941 compared with 271 kg. valued at $241,987 in 1940. No large companies operate in the republic, as virtually all the gold is produced from numerous small placers. Hand washing of the gravel is still largely used; daily returns are small. Lode deposits are known but have been little developed. No silver is produced in this country.

Nicaragua.—Gold production in Nicaragua has shown a phenomenal rise during the last 10 years. From a value of $382,189 in 1932, production leaped to $7,323,265 in 1941, an increase of about 1800 percent. Silver production also increased from a value of $11,100 in 1932 to $93,553 in 1941, although the value of production in 1940 was $100,149.

The La Luz Mines, Ltd., led in total gold and silver produced in 1941 with 75,047 ounces of gold valued at $2,619,884 and 32,383 ounces of silver valued at $10,988. Next in rank was the Compañia Minera la India with a production of 32,732 ounces of gold valued at $1,134,879 and 41,424 ounces of silver valued at $13,624. Other important producers included the Neptune Gold Mining Co., the San Juan Mines Co., the Compañia Minera del Jabali, the Compañia Minas Matagalpa, and the Empresa Minera de Nicaragua.

Guatemala.—Production of gold in Guatemala during the past 11 years reached a peak in 1931 when 294 kg. were produced. Since 1932 little more than half this amount has been derived in any year, and in 1941 only 78 kg. were produced. This country has no known workable deposits of silver.

Panama.—Production of gold in Panama during the past decade reached its peak in 1934 when 13,895 fine ounces were produced. Since that year, output has steadily declined, except for 1937 when a temporary revival was experienced. Production in 1941 totaled only 2,115 ounces.

The higher production from 1934 to 1937 was due mainly to the development of two mines in gold-quartz veins in the San Francisco and Santa Fe districts in the Province of Veraguas. Operations in these districts ceased in 1937.

Since 1938 most of the gold has come from small placer operations in nearly every territory in the country. Large defense projects in the Canal Zone and inability to get mining machinery are the two

factors responsible for the decline of gold mining in Panama in the last 2 years.

Silver has been of minor importance in Panama; no production has been reported since 1936.

SOUTH AMERICA

Argentina.—Silver production in Argentina amounted to 3,978,400 fine ounces in 1941 compared with 3,242,200 ounces in 1940. Gold in 1940 amounted to 12,860 fine ounces; figures for 1941 are not available. More than half of the gold is produced from placers. Six gold mines have been reported in production, one in the Province of La Rioja, one in the Andes territory, and four in the territory of Neuguén. The silver is largely produced from lead concentrates.

Bolivia.—Bolivia's production of 8,158 fine ounces of gold in 1941 was divided among eight principal producers, of which the Empresa Minera la Joya accounted for about 65 percent of the total. This company produces gold from auriferous pyrites. Five principal producers of silver supplied nearly all of the country's 7,348,695 ounces. Gold and silver mining is being handicapped by lack of ocean transportation of the ore to United States smelters; also, it is not possible to obtain mining equipment from the United States.

Brazil.—In 1941 Brazil produced 147,309 fine ounces of gold from lode mines; no data are available on placers, except that prospectors are still very active along the gold-bearing streams. All but a small part of Brazil's gold comes from the State of Minas Gerais, where there are two important mines. These are the Morro Velho and the Passagem, where the gold occurs in extensive ore shoots along the planes of schistose rocks. The Morro Velho is over 8,000 feet deep.

Some gold is also produced in the States of Paraná, Rio Grande do Sul, São Paulo, Goias, and Maranhão.

Silver production in Brazil is small, amounting to only 21,170 fine ounces in 1941.

Colombia.—Since 1931 the production of both gold and silver has gained steadily in Colombia, and 1941 was the high year for each metal. Of the 656,019 fine ounces of gold produced in 1941, about 60 percent came from placers and 40 percent from lodes. Most of the placer gold is recovered by dredges, eight being in operation in 1941. Hydraulicking was carried on by 60 operators. Two companies produced most of the lode gold, but 53 small operators also reported production.

Colombia's production of 271,115 ounces of silver in 1941 came almost entirely as a byproduct of gold mining

Ecuador.—The 70,264 ounces of gold and the 116,836 ounces of silver produced in Ecuador in 1941 came almost entirely from the operations of two companies—the Cotopaxi Exploration Co. and the South American Development Co. Six other companies carried on exploration work.

Guianas.—Information on the Guianas is almost nonexistent. It is estimated that British Guiana produced about 30,000 ounces of silver in 1941, French Guiana about 35,000 ounces, and Surinam about 12,000 ounces.

Gold production from British Guiana probably amounted to a few thousand ounces. One company working in British Guiana holds about 900 acres of dredging concessions, over 66,000 acres of exclusive permissions, and 3,000 acres of claims. These holdings are centered in the Mahdia, Potaro, Konawaruk, and Essequibo areas. The gravel is stated to carry 2.90 to 5 grains of gold per cubic yard.

Surinam for several years has produced over 400,000 grams of gold annually, all of which has been won from placers by the use of long toms, sluices, and hand pans.

Peru.—Peru, with an output of over 15,000,000 ounces of silver, furnished more than half of the total 28,105,000 ounces produced in South America in 1941.

COPPER

By T. H. Miller and H. M. Meyer

SUMMARY OUTLINE

GENERAL SUMMARY

The inability of copper producers to meet all requirements, evident in the latter half of 1940, was accentuated in 1941. Copper was consumed at an astounding rate in the United States for its own military requirements, for the needs of its Allies, and for civilian uses, exceeding previous records by 40 to 50 percent. A demand of unknown proportions could not be filled. Consumption doubtless would have been much larger had enough metal been available to fabricators for unrestricted use.

The trend of events throughout 1940 and 1941 forced many observers to revise their opinions regarding the adequacy of copper supplies in the United States. When the present World War began, few would have believed that domestic production plus unprecedented imports could fall so far short of satisfying all needs. The British Empire's position as regards copper was then considered relatively satisfactory, and when the tremendous resources of the United States were added, no problem regarding supplies of the metal was generally anticipated. This opinion, of course, held before the United States entered the war and before it was known that this country must supply copper in fabricated form to virtually all the nations at war with the Axis Powers or preparing to resist them. The unbelievable growth in plans for airplanes, tanks, and other munitions made all previous ideas regarding consumption requirements obsolete.

Supply problems.—Early in 1941, as data on military requirements were made public, it became evident that civilian use of copper would have to be drastically curtailed. Defense agencies studied at length the problems of estimated needs and supplies from domestic and foreign mines before copper was placed under mandatory industry-wide control, effective June 1. The order provided for the setting aside of a producers' pool to be allocated by the Director of Priorities and the filling of defense orders, according to preference ratings, before any shipments for civilian use were made. All copper owned by the Metals Reserve Co. on and after June 1 was also to be allocated by the Director of Priorities.

When the order was issued the Director of Priorities announced that the total supply of copper in 1941 was expected to be between 1,340,000 and 1,470,000 tons, whereas total military and civilian

requirements were estimated at 1,810,000 tons, indicating an expected shortage of 340,000 to 470,000 tons. Later in the year the estimates for 1941 were revised, and data for 1942 were added. The new estimates showed that the emergency in regard to copper supplies was growing worse rapidly and foretold more stringent controls on civilian use of copper as the war progressed. This dark outlook prevailed when plans for overwhelming military dominance of the world had not reached their peak. Figures released by the Office of Emergency Management in October are quoted below, in short tons:

	1941	*1942*
Supply:		
Domestic production	950, 000	1, 100, 000
Imports (Latin America)	500, 000	500, 000
Other imports	100, 000	100, 000
Secondary copper	100, 000	100, 000
	1, 650, 000	1, 800, 000
Demand:		
Military [1]	600, 000	1, 000, 000
Essential civilian	400, 000	400, 000
Other civilian	880, 000	1, 170, 000
	1, 880, 000	2, 570, 000

[1] Includes foreign.

The agency explained that the large "other civilian" demands were predicated on the theory of unrestricted consumption to fit in with the rise in national income under the defense program.

Salient statistics of the copper industry in the United States, 1925–29 (average) and 1938–41, in short tons

	Average (1925–29)	1938	1939	1940	1941
New copper produced—					
From domestic ores, as reported by—					
Mines	885, 826	557, 763	728, 320	878, 086	958, 149
Ore produced:					
Copper ore	59, 505, 871	[1 2] 37,794,938	[1] 55, 239, 098	[1] 69, 278, 476	(3)
Average yield of copper, percent	1 44	1. 34	1 25	1 20	(3)
Smelters	892, 730	562, 328	712, 675	909, 084	966, 072
Percent of world total	51	25	30	(3)	(3)
Refineries	890, 767	552, 574	704, 873	927, 239	975, 408
From foreign ores, matte, etc., refinery reports	317, 287	239, 842	304, 642	386, 317	419, 901
Total new refined, domestic and foreign	1. 208, 054	792, 416	1, 009, 515	1, 313, 556	1, 395, 309
Secondary copper recovered from old scrap only	347, 512	267, 300	286, 900	333, 890	412, 699
Copper content of copper sulfate produced by refiners	4. 601	4, 978	4, 868	5, 643	6, 984
Total production, new and old and domestic and foreign	1, 560, 167	1, 064. 694	1, 301, 283	1, 653, 089	1, 814, 992
Imports (unmanufactured) [4]	391, 212	252, 164	336, 297	491, 342	[5] 524, 974
Refined [4]	59, 236	1, 802	16, 264	68, 337	[5] 220, 762
Exports of metallic copper [6]	522, 616	421, 012	427, 517	427, 650	[5] 107, 793
Refined (ingots, bars, rods, etc)	482, 868	385, 223	396, 406	377, 108	[5] 77, 824
Stocks at end of year	307, 200	414, 000	355, 500	334, 500	317, 500
Refined copper	86, 100	181, 000	95, 500	91, 500	77, 500
Blister and materials in solution	221. 100	233, 000	260, 000	243, 000	240, 000
Withdrawals from total supply on domestic account:					
Total new copper	778, 123	406, 994	714, 873	1, 008, 785	(7)
Total new and old copper	1, 288, 700	767, 000	1, 215, 000	1, 541, 000	(7)
Price, average ..cents per pound	14 7	9 8	10 4	11. 3	11 8
World smelter production, new copper	1, 761, 000	2, 254, 000	[8] 2, 405, 000	(3)	(3)

[1] Includes old tailings.
[2] Exclusive of Alaska, figures for which Bureau of Mines not at liberty to publish.
[3] Figures not yet available.
[4] Data include copper imported for immediate consumption plus material entering country under bond.
[5] Figures cover 9 months only; data for last quarter of year confidential.
[6] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which figures of quantity not recorded.
[7] Bureau of Mines not at liberty to publish calculated totals owing to confidential nature of foreign trade data for last quarter of year.
[8] Approximate.

General Preference Order M-9 was amended in July to extend control to copper-base alloys and fabricated products made from copper or from copper-base alloys, such as brass or bronze; and Order M-9-A, issued August 2, placed copper and copper-base alloys under 100-percent priority control.

In an order dated September 30, copper scrap also was placed under full priority control. The order stated that copper ranked next to aluminum as the most difficult of the critical metals to obtain in quantities sufficient for defense and civilian needs. Priority assistance was granted Latin-American copper mines on October 15 to enable them to obtain necessary maintenance materials and operating supplies more rapidly. This action marked another effort to improve the supply-demand situation by helping to increase production in the affected countries.

Amendments and revisions of the conservation orders mentioned above were issued subsequently from time to time, partly to clarify them and to withdraw some unsatisfactory features but mainly to tighten controls further and to restrict unnecessary uses. There have been repercussions among many other metals as a result of the copper-conservation orders. In saving copper, the secondary effect of the orders has been to release large and small quantities of other metals normally alloyed with copper in the restricted uses. The extent of the effects on other metals has been somewhat startling.

Jeffries [1] has prepared a report on copper conservation.

Percy Barbour, in the American Metal Market of September 23, 1941, questioned the accuracy of defense agency data on requirements for war and civilian consumption, contending that they were too high; and Arthur Notman, in a statement reprinted from the New York Sun in Metals, January 1942, was inclined to agree. Barbour pointed out that civilian requirements were calculated by adding wartime to peacetime demand and, in addition, that Army and Navy estimates were well-known to be on the ample side. He also pointed out that the amount of copper available for German consumption during the period of preparation for war, 1933-38, was considerably below half of the estimated requirements of Great Britain and the United States for 1 year.

Price action.—The strain on supplies of copper in 1941 paved the way for sharply increased prices. In deference to the expressed interest of the Office of Price Administration in preventing price advances for this commodity, as well as for others, large producers maintained a price of 12 cents a pound for electrolytic copper, delivered Connecticut Valley, until August 12. For more than 6 months, custom smelters and small producers obtained premiums for nearby metal. On August 12 a ceiling of 12 cents for copper was established by the Price Administrator, and it has remained at that level beyond the time of the preparation of this report (June 1942). This inactivity of prices contrasts directly with the movement of prices in the previous World War. The average quoted price for electrolytic copper, New York, was 13.6 cents in 1914, 17.3 cents in 1915, and 27.2 cents in 1916. An agreement between copper producers and the War Industries Board fixed the maximum price for copper, f. o. b. New York, at

[1] Jeffries, Zay, A Program for Conservation of Copper: One of a series of reports by the Advisory Committee on Metals and Minerals, Clyde E. Williams, chairman, submitted to the Office of Production Management through F. B. Jewett, president of the National Academy of Sciences; reprinted in several technical journals.

23.5 cents a pound on September 21, 1917. This price remained in force until July 2, 1918, when it was advanced to 26 cents.

During the year the Office of Price Administration had been investigating means of encouraging marginal mines to produce copper, lead, and zinc without increasing the prices paid for the bulk of production. Late in 1941 arrangements were made for Government purchase of copper from three Michigan companies at 1 cent a pound above "out-of-pocket" costs. In January 1942 it was announced that the Metals Reserve Co. would purchase copper output above quotas at 17 cents a pound, Connecticut Valley, for 2½ years. Quotas were to be assigned by the Office of Production Management and the Office of Price Administration, and beginning February 1, 1942, production was to be entitled to the premium price. Any metals acquired at premium prices by Metals Reserve Co., which were not used for or by the Government, were subject to allocation to consumers at the ceiling prices fixed by the Price Administrator.

Government purchasing.—As stated in the chapter on Copper in Minerals Yearbook, Review of 1940, arrangements to purchase Latin American copper were begun in the final quarter of 1940, when it became apparent that production in the United States would be inadequate for all requirements. First Government contracts, announced December 19, 1940, totaled 100,000 short tons, distributed among Anaconda Copper Mining Co., Kennecott Copper Corporation, American Metal Co., Ltd. (Cerro de Pasco Co.), and Phelps Dodge Corporation. The 1941 stockholders' report of the Anaconda Copper Mining Co. stated that, beginning March 1941, large quantities of copper produced by their foreign subsidiaries were delivered to Metals Reserve Co. and that, with the exception of comparatively small quantities required for Latin America, the entire output was currently being sold and delivered to that organization. The report stated that the price paid by Metals Reserve Co. was the equivalent of 9½ cents a pound f. a. s. Chilean ports until October 8, when it was advanced to the equivalent of 10¾ cents f. a. s. Chile, applicable to deliveries made during September, October, November, and December. Effective January 1, 1942, the price was increased to 11¼ cents, which, the report stated, was the current price under which foreign production was being delivered to the Government (the report was dated April 11, 1942). The annual report of the Kennecott Copper Corporation stated that the Braden Copper Co. (a Kennecott subsidiary) delivered virtually all of its 1941 production, most of which was fire-refined copper, to the Metals Reserve Co.

In May 1942 Jesse Jones, Administrator of the Reconstruction Finance Corporation, of which Metals Reserve Co. is a subsidiary, stated before the Senate Committee on Banking and Currency that his organization had purchased 760,000 tons of copper from Latin American countries and in addition intended to import metal from New Zealand, Australia, and Africa.

The Government also arranged during the year to acquire metal, belonging to France and other countries, which was stranded in the United States.

In May 1942 the Copper Recovery Corporation was formed to act as agent for the Metals Reserve Co. and to plan for physical transfer and payment for 300,000 tons of copper and brass products saved for military uses by limitation and conservation orders of the War Pro-

duction Board (formerly Office of Production Management). Where possible, the metal was to be used to fill military requirements for shapes and grades in the form in which it was held in inventory. The stocks were expected to yield 255,000 tons of copper and about 45,000 tons of zinc.

Prospects for increased production.—Development of the open-pit copper mine at Morenci, Ariz., begun in 1937, promised an annual production of 75,000 tons of copper a year. The first ore was sent to the Morenci mill in January 1942; the smelter started later, and capacity operations were expected by about July. Following the declaration of war on Japan, a 7-day week was adopted at some large properties that had been operating upon a shorter-week basis. As a result of the longer work period, properties of the Anaconda Copper Mining Co. were expected to yield an additional 24,000 to 36,000 tons of copper a year and those of the Phelps Dodge Corporation 12,000 tons more. The Kennecott Copper Corporation was already upon a 7-day basis. Increased facilities at Inspiration Consolidated were expected to yield another 12,000 tons of copper annually, beginning early in 1942.

Contracts between the Metals Reserve Co. and the Defense Plant Corporation (both Reconstruction Finance Corporation subsidiaries) and mining companies forecast the following annual increments to domestic supply:

	Short tons
Bagdad Copper, Ariz	10, 200
Calumet and Hecla, Mich	1, 250
Gray Eagle Mining, Calif	6, 800
Castle Dome, Ariz	23, 000
National Tunnel & Mines, Utah	5, 000
Phelps Dodge,[1] Ariz	60, 000
	106, 250

[1] Additional at Morenci.

Bonus prices paid by the Metals Reserve Co. for above-quota copper production, already mentioned under the discussion on price action, will contribute an additional unknown amount to domestic supply.

Arizona report on marginal production.—During the year the Arizona Department of Mineral Resources, at the request of the Arizona Copper Tariff Board, prepared a report on the production possibilities of marginal mines in Arizona, which it submitted on August 1 to the Office of Price Administration and Civilian Supply. The report stated that an increase in the price of copper to 14 cents a pound could result in an additional output of 55,000,000 pounds of copper yearly by small mines in Arizona (85,000,000 pounds if the Inspiration Consolidated Copper Co., one of the major producers, is considered) provided a return of the necessary capital investment could be guaranteed. Further advance to 16 cents would bring out an additional 32,000,000 pounds, the report stated, but advances to higher levels would result in less-important gains.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled upon a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better

for showing the actual recovery of metal and fairly accurate for showing the source of production; and refinery statistics give precise information regarding metal recovery but indicate only in a general way the source of crude materials treated. The chapter on Copper in Mineral Resources of the United States, 1930, part 1, discusses the differences among the three sets of figures.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1937–41, in pounds

Year	Mine	Smelter	Refinery
1937	1,683,996,000	1,669,322,278	1,644,505,129
1938	1,115,525,160	1,124,656,539	1,105,148,323
1939	1,456,639,000	1,425,349,488	1,409,745,816
1940	1,756,172,000	1,818,167,516	1,854,478,996
1941	1,916,298,000	1,932,144,953	1,950,816,680

PRIMARY COPPER

Smelter production.—The recovery of copper by United States smelters from ores of domestic origin totaled 1,932,144,953 pounds in 1941—a 6-percent increase over 1940. Domestic smelter output constituted 51 percent of the world production during 1925–29. The proportion dropped sharply in the succeeding years until 1934, when it was only 17 percent. It rose to 32 percent in 1936 and since then has never fallen below 25 percent, fluctuating between the two figures. The proportion was believed to be close to the higher level of the range in 1940 and 1941 and possibly exceeded it somewhat in the latter year.

The figures for smelter production are based upon confidential returns from all smelters handling copper-bearing materials produced in the United States. For Michigan the sum of furnace-refined copper and copper cast into anodes for electrolytic refining is included. The figures for blister represent the fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production. Metallic and cement copper recovered by leaching is included in smelter production.

The precise quantity, in pounds, of copper produced by smelters in the United States and its value are shown by years for 1845–1930 in the Copper chapter of Mineral Resources of the United States, 1930, part 1.

Copper produced in the United States from domestic ores, 1937–41, by States

[Smelter output, in pounds fine]

State	1937	1938	1939	1940	1941
Alabama	18,820				
Alaska	42,215,119	33,492,746	304,000	128,001	190,003
Arizona	580,493,036	420,351,310	525,410,905	574,533,050	657,100,101
California	10,615,215	1,680,754	8,490,872	13,091,643	8,029,066
Colorado	21,826,209	30,563,654	25,548,762	26,372,851	12,966,327
Georgia		70		25,917	
Idaho	4,804,162	5,611,392	4,632,415	7,379,389	7,101,877
Michigan	84,751,478	75,281,469	89,402,464	91,486,806	93,503,895
Missouri	695,569	625,844	1,020,000	1,638,000	1,546,526
Montana	280,662,270	156,249,794	203,512,107	258,141,139	257,424,059
Nevada	149,963,847	93,655,642	128,844,525	157,241,576	161,035,989
New Mexico	63,573,985	43,913,133	74,083,586	140,968,734	147,696,312

Copper produced in the United States from domestic ores, 1937–41, by States—Con.

[Smelter output, in pounds fine]

State	1937	1938	1939	1940	1941
North Carolina	(1)	(1)	(1)	(1)	(1)
Oregon	870,102	88,670	95,557	202,527	167,899
Pennsylvania	(1)	(1)	(1)	(1)	(1)
South Carolina	136	7,893	66	----------	----------
South Dakota	----------	----------	----------	12,037	----------
Tennessee	(1)	(1)	(1)	(1)	(1)
Texas	316,102	35,740	66,000	66,000	14,000
Utah	404,168,742	229,876,860	326,117,467	497,463,560	541,293,973
Virginia	953	43,279	741	----------	----------
Washington	124,422	12,494,297	16,756,007	21,022,000	17,334,000
Wyoming	75	155	----------	4,018	8,000
Undistributed	24,222,036	20,683,837	21,064,014	28,390,268	26,732,926
	1,669,322,278	1,124,656,539	1,425,349,488	1,818,167,516	1,932,144,953

1 Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

Copper produced (smelter output) in the United States, 1937–41, and total 1845–1941

[Values rounded]

Year	Short tons	Value
1937	834,661	$201,988,000
1938	562,328	110,216,000
1939	712,675	148,236,000
1940	909,084	205,453,000
1941	966,072	227,993,000
Total 1845–1941	28,464,550	8,480,013,000

Mine production.—The figures for mine production are based upon reports supplied to the Bureau of Mines by all domestic mines that produce copper. Details of the method of collecting the statistics and reasons for the discrepancy between mine-, smelter-, and refinery-production figures are given in the Copper chapter of Mineral Resources of the United States, 1930, part 1.

Mine production is more accurate than either refinery or smelter production for showing the distribution of domestic output by States and districts. It also indicates the production by calendar years more exactly, because additional time is required for smelting and refining. Mine production in 1941 was 1,916,298,000 pounds—an increase of 9 percent over that in 1940 and 8 percent above the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1940 and 1941 and mine output by districts for 1937–41. In 1941 Arizona, Utah, and Montana led in production, with 75 percent of the smelter total compared with 73 percent in 1940; adding the output of Nevada, New Mexico, and Michigan to the foregoing brings the proportions to 96 percent of the total for the country compared with 95 percent in 1940. Arizona supplied 34 percent compared with 28 percent for Utah and 13 percent for Montana. Both Arizona and Utah made noteworthy gains in output, and these States contributed a greater proportion of the country's total; Montana's output was relatively unchanged, and its share of the total therefore declined. There was nothing outstanding

among the increases for other producing States; and some States, notably Colorado, California, and Washington, recorded decreases. Comparison of present production with that of the past century shows that Arizona is now producing at about the same rate in relation to the country total as over the entire period 1845–1941; Montana's and Michigan's shares in 1941 (13 and 5 percent, respectively) mark declines from 21 and 16 percent during 1845–1941; and Utah's sharply increased proportion of 28 percent (compared with 13 percent) partly offsets the relative decreases indicated for Montana and Michigan. Nevada and New Mexico are now producing considerably larger proportions of the country's total than in 1845–1941.

Copper produced in the United States, according to smelter and mine returns, by States, 1940–41 and 1845–1941, in short tons

State	1940		1941			1845-1941, smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns	Total quantity	Percent of total
			Percent of total	Quantity			
Alaska	64	55	0.01	95	72	676,783	2.38
Arizona	287,266	281,169	34.01	328,550	326,317	9,414,487	33.07
California	6,549	6,438	.42	4,015	3,943	574,471	2.02
Colorado	13,186	12,152	.67	6,483	6,748	271,515	.95
Georgia	13	13	-----	-----	-----	(1)	(1)
Idaho	3,689	3,349	.37	3,551	3,621	91,490	.32
Michigan	45,743	45,198	4.84	46,752	46,440	4,637,385	16.29
Missouri	819	685	.08	773	1,400	(1)	(1)
Montana	129,070	126,391	13.32	128,712	128,036	6,082,756	21.37
Nevada	78,621	78,454	8.33	80,518	78,911	1,453,477	5.11
New Mexico	70,484	69,848	7.64	73,848	73,478	1,010,303	3.55
North Carolina	(2)	(2)	(2)	(2)	(2)	(1)	(1)
Oregon	101	88	.01	84	83	11,535	.04
Pennsylvania	(2)	(2)	(2)	(2)	(2)	(1)	(1)
South Carolina	-----	(3)	-----	-----	(3)	(1)	(1)
South Dakota	6	6	-----	-----	-----	(1)	(1)
Tennessee	(2)	(2)	(2)	(2)	(2)	[4] 259,508	[4] .91
Texas	33	30	(5)	7	6	(1)	(1)
Utah	248,732	231,864	28.02	270,647	266,838	3,667,738	12.89
Virginia	-----	-----	-----	-----	-----	(1)	(1)
Washington	10,511	9,612	.90	8,667	8,686	48,276	.17
Wyoming	2	2	(5)	4	4	15,869	.06
Undistributed	14,195	12,732	1.38	13,366	13,566	[6] 248,957	.87
	909,084	878,086	100.00	966,072	958,149	28,464,550	100.00

[1] Included under "Undistributed"; figures not separately recorded.
[2] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[3] Less than 1 ton.
[4] Approximate production through 1928. Figures for 1929–41 confidential and included under "Undistributed."
[5] Less than 0.01 percent.
[6] Includes Tennessee for 1929–41.

In 1941, for the sixth consecutive year, the Bingham (Utah) district was the largest copper producer in the United States; its output was slightly more than double that of Butte (Mont.), for 6 years its nearest competitor and before 1936 usually ahead of Bingham in copper production. Following Globe-Miami (Ariz.), which has ranked third for a number of years, is a group of districts that frequently change places in importance as copper producers.

Details of mine production, by districts and companies, in 1941 are available in the chapters of this volume dealing with the production of gold, silver, copper, lead, and zinc in the various States.

Mine production of copper in the principal districts of the United States,[1] 1937–41 in terms of recovered copper, in short tons

District or region	State	1937	1938	1939	1940	1941
Bingham	Utah	203,421	106,049	167,856	228,505	264,705
Butte	Montana	143,879	76,855	97,266	125,442	127,431
Globe-Miami	Arizona	88,509	44,528	62,400	70,406	82,419
Central (including Santa Rita)	New Mexico	29,464	16,557	42,344	64,991	67,727
Ely (Robinson)	Nevada	56,706	38,501	51,590	63,840	67,171
Ajo	Arizona	55,375	43,180	49,871	51,566	65,880
Bisbee (Warren)	do	55,991	47,518	54,617	55,254	56,592
Lake Superior	Michigan	47,464	46,743	43,985	45,198	46,440
Yavapai County (mostly Jerome district)	Arizona	43,403	29,437	38,203	38,201	43,701
Ray (Mineral Creek)	do	17,308	15,029	21,583	31,729	42,400
Pioneer	do	17,104	17,167	17,958	18,450	19,121
Copper Mountain (Morenci-Metcalf)	do	6,822	11,148	15,878	13,503	13,879
Cope	Nevada	16,588	6,563	14,065	13,542	10,756
Chelan Lake	Washington		5,931	8,786	9,288	8,365
Red Cliff (Battle Mountain)	Colorado	9,458	12,013	11,921	10,552	5,609
Lordsburg	New Mexico	1,904	3,173	3,184	3,278	3,734
Plumas County	California	4,939	602	4,029	5,293	3,644
Coeur d'Alene region	Idaho	1,944	1,883	2,068	2,680	2,979
Tintic	Utah	1,331	1,177	1,413	1,295	1,042
San Pedro	New Mexico	44	44	336	1,394	719
San Juan Mountains	Colorado	1,142	1,819	981	1,209	705
Ophir	Utah	391	437	2,070	1,095	204
Bunker Hill	Arizona	1,396	1,626	246	8	11
Copper River [2]	Alaska	[3] 17,336	[3] 14,549	(4)	(4)	(4)
Swain County [2]	North Carolina	(5)	(5)	(5)	(5)	(5)
Lebanon (Cornwall mine) [2]	Pennsylvania	(5)	(5)	(5)	(5)	(5)
Ducktown [2]	Tennessee	(5)	(5)	(5)	(5)	(5)

[1] Districts producing 1,000 short tons or more in any year of the period 1937–41.
[2] Not listed in order of output
[3] Includes a small quantity produced elsewhere in Alaska
[4] Negligible
[5] Bureau of Mines not at liberty to publish figures.

Quantity and estimated recoverable content of copper-bearing ores.—The following tables list the quantity and estimated recoverable copper content of the ore produced by mines in the United States in 1940; figures for 1941 are not yet available. Of the total copper produced from copper ores in the United States in 1940, 84 percent was obtained from ores concentrated before smelting and 11 percent from direct-smelting ores; in addition, copper was recovered from 3,198,904 tons of copper ore treated by straight leaching. The percentages for 1940 compare with 81 percent obtained from concentrated ore (including ores treated by combined leaching and flotation) and 16 percent from direct-smelting ores in 1939. In 1939, 2,114,407 tons of copper ore were treated by straight leaching.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that the estimated recoverable tenor is close to the actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. "Copper ores" include not only those that contain 2.5 percent or more copper but also those that contain less than this percentage if they are valuable chiefly for copper. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic ores.

Copper ore, old tailings, etc., sold or treated in the United States in 1940, with copper, gold, and silver content in terms of recovered metals

State	Ore, old tailings, etc., sold or treated (short tons)	Copper produced: Pounds	Copper produced: Percent	Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
Arizona	20,284,826	[1] [2] 525,163,470	1.29	128,720	4,463,702	$0.38
California	446,392	12,326,100	1.38	16,669	291,914	1.77
Colorado	334,312	21,254,198	3.18	30,331	6,765,877	17.57
Idaho	4,931	695,365	7.05	597	17,762	6.80
Michigan	4,438,219	90,396,000	1.02		88,657	[3] .41
Montana	3,287,803	[1] 243,663,241	3.71	11,708	6,039,027	1.43
Nevada	6,158,388	156,434,000	1.27	59,325	339,810	.38
New Mexico	6,606,471	[1] 129,592,547	.98	13,202	369,968	.11
Oregon	146	30,100	10.31	6	2,696	14.57
Texas	3	300	5.00			
Utah	26,301,745	[1] 439,544,601	.84	223,156	2,132,727	.35
Washington	689,325	18,864,662	1.37	51,529	218,861	2.84
Wyoming	30	4,000	6.67		38	.90
Eastern States	[4] 725,885	25,463,900		2,115	56,367	
	[4] 69,278,476	[1] 1,663,432,484	1.20	537,358	20,787,406	48

[1] Excludes copper recovered from mine-water precipitates as follows: Arizona, 32,737,425 pounds; Montana, 5,624,886; New Mexico, 8,258,984; and Utah, 14,223,006.
[2] Includes small quantity of copper from copper concentrates derived from tungsten ore.
[3] Calculated only on ore that yielded silver.
[4] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper ore, old tailings, etc., concentrated in the United States in 1940, with content in terms of recovered copper

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Copper from ore, etc. (percent)
Arizona	[1] 15,530,822	772,845	[2] 314,986,799	1.01
California	437,508	20,881	10,573,900	1.21
Colorado	1,764	503	114,000	3.23
Idaho	160	39	9,631	3.01
Michigan	4,438,219	69,226	90,396,000	1.02
Montana	3,248,544	513,900	241,277,039	3.71
Nevada	6,117,071	269,862	143,291,800	1.17
New Mexico	6,522,903	207,151	124,576,849	.95
Utah	26,296,475	681,231	439,023,871	.83
Washington	688,946	38,766	18,720,971	1.36
Eastern States	[3] 618,100	53,043	21,126,000	
	63,900,512	2,627,447	1,404,096,860	1.10

[1] Excludes 3,198,904 tons of copper ore treated by straight leaching.
[2] Excludes 70,589,712 pounds of electrolytic copper from copper ore treated by straight leaching.
[3] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper ore, old tailings, etc., smelted in the United States in 1940, with content in terms of recovered copper, and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc., smelted: Short tons	Ore, old tailings, etc., smelted: Copper produced (pounds)	Ore, old tailings, etc., smelted: Percent of copper	Copper from all sources including old slags, smelter cleanings, and precipitates (pounds)
Alaska				110,000
Arizona	1,555,100	139,509,459	4 49	[1] 562,338,000
California	8,884	1,752,200	9 86	12,876,000
Colorado	332,548	21,140,198	3 18	24,304,000
Idaho	4,771	685,734	7 19	[2] 6,698,000
Michigan				90,396,000
Missouri				1,370,000
Montana	39,259	2,386,202	3.04	[1] 252,782,000
Nevada	41,317	13,142,200	15 90	156,908,000
New Mexico	83,568	5,015,698	3 00	[1] 139,696,000
Oregon	146	30,100	10.31	176,000
South Dakota				12,000
Texas	3	300	5 00	60,000
Utah	5,270	520,730	4.94	[3] 463,728,000
Washington	379	143,691	18.96	19,224,000
Wyoming	30	4,000	6 67	4,000
Eastern States	107,785	4,337,900	2 01	25,490,000
	2,179,060	188,668,412	4 33	1,756,172,000

[1] Considerable copper was recovered from mine-water precipitates.
[2] Mostly recovered from ores classed as dry and siliceous silver and zinc-lead.
[3] Considerable copper was recovered from mine-water precipitates and from ores classed as dry and siliceous, zinc-lead, and zinc-lead-copper.

Copper ores produced in the United States, 1936–40, and average yield in copper, gold, and silver

Year	Smelting ores [1]: Short tons	Smelting ores [1]: Yield in copper (percent)	Concentrating ores [1]: Short tons	Concentrating ores [1]: Yield in copper (percent)	Total: Short tons [1]	Total: Yield in copper (percent)	Total: Yield per ton in gold (ounce)	Total: Yield per ton in silver (ounce)	Total: Value per ton in gold and silver
1936	2,388,635	5 05	36,116,692	1 31	38,514,245	1 54	0 0099	0.453	$0.70
1937	[2] 2,763,184	4 30	[2] 58,737,922	1 15	[2] 61,513,148	1 29	.0081	.327	.53
1938	[2] 2,028,000	4.49	[2] 34,374,026	1 17	[2] 37,794,938	1 34	.0090	.414	.58
1939	2,396,155	4 61	50,710,026	1 09	55,239,098	1 25	.0085	.333	.52
1940	2,179,060	4 33	63,900,512	1.10	69,278,476	1.20	.0078	.300	.48

[1] Includes old tailings, etc.
[2] Exclusive of Alaska, figures for which Bureau of Mines not at liberty to publish.

REFINERY PRODUCTION

The refinery output of copper in the United States in 1941 was made by 10 plants; 8 of these employed the electrolytic method and 2 the furnace process on Lake Superior copper.

There are five large electrolytic refineries on the Atlantic seaboard, three Lake refineries on the Great Lakes, and three refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; and one at El Paso, Tex. Of the above plants, the Lake refinery of the Quincy Mining Co. has been idle since 1933.

In addition to the foregoing plants, that at Inspiration, Ariz., is equipped to make electrolytically refined copper direct from the liquors obtained from leaching; this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes.

The 12 plants indicated constitute what commonly are termed "regular refineries." Of these plants, 9 employ the electrolytic process and 3 the furnace process. The electrolytic plants have a rated capacity of 1,561,000 tons of refined copper a year. As they produced 1,445,000 short tons in 1941, this part of the industry was operated at 93 percent of capacity.

Early in June 1942, the Phelps Dodge Corporation announced the letting of a contract for expansion in its electrolytic plant at El Paso. The cost was reputed to be $2,650,000, and plans were reported to include a 50-percent increase in capacity of furnace and tank house. The increased capacity is required to take care of expansion in mine and smelter production at Morenci, Ariz.

The following tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which cast.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1937–41, in pounds

	1937	1938	1939	1940	1941
Primary:					
Domestic:[1]					
Electrolytic[2]	1,548,857,307	1,032,976,656	1,324,817,430	1,767,219,614	1,859,421,387
Lake[2]	84,007,120	72,021,341	84,928,386	87,259,382	91,395,293
Casting	11,640,702	150,326			
	1,644,505,129	1,105,148,323	1,409,745,816	1,854,478,996	1,950,816,680
Foreign:[1]					
Electrolytic	486,285,376	479,635,732	609,284,939	772,633,048	839,800,708
Casting and best select	2,837,298	47,674			
Refinery production, new copper	2,133,627,803	1,584,831,729	2,019,030,755	2,627,112,044	2,790,617,388
Imports, refined copper[3]	14,974,815	3,603,025	32,527,473	136,674,143	[4] 441,523,575
Total new refined copper made available	2,148,602,618	1,588,434,754	2,051,558,228	2,763,786,187	(5)
Secondary:					
Electrolytic[6]	312,831,103	185,084,601	233,225,695	235,337,792	190,873,847
Casting	380,000				8,476,000
	313,211,103	185,084,601	233,225,695	235,337,792	199,349,847
Grand total	2,461,813,721	1,773,519,355	2,284,783,923	2,999,123,979	(5)

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[2] Some copper from Michigan is electrolytically refined at eastern refineries and is included as electrolytic copper.
[3] Data include copper imported for immediate consumption plus material entering country under bond.
[4] Figures cover January to September, inclusive. Data for last quarter not available for publication.
[5] Bureau of Mines not at liberty to publish, owing to confidential nature of import figures for last 3 months of year.
[6] Includes some secondary Lake copper.

Copper cast in forms in the United States, 1940–41

Form	1940		1941	
	Pounds	Percent	Pounds	Percent
Wire bars	1,245,000,000	43.50	1,472,000,000	49.23
Cathodes	906,000,000	31.66	601,000,000	20.10
Cakes	293,000,000	10 24	383,000,000	12.81
Ingots	175,000,000	6.11	257,000,000	8.60
Other forms	243,000,000	8 49	277,000,000	9.26
	2,862,000,000	100.00	2,990,000,000	100.00

In addition to the regular refineries, numerous plants throughout the country operate on scrap exclusively, producing metallic copper and a great variety of alloys. The output of these plants is not included in the statements of refined-copper production in the preceding tables but is included in the following statement of secondary-copper production.

Copper sulfate.—The production of hydrous copper sulfate or bluestone by copper refineries in the United States was 54,833,327 pounds having a copper content of 13,967,000 pounds in 1941 compared with 44,308,107 and 11,286,000 pounds, respectively, in 1940. The output of copper sulfate by plants other than the regular primary refineries was 116,143,533 pounds with a reported copper content of 29,368,000 pounds in 1941 compared with 89,723,720 pounds containing 22,808,000 pounds of copper in 1940.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during 1937–41. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary copper produced in the United States, 1937–41, in short tons

	1937	1938	1939	1940	1941
Copper as metal	285,600	192,400	151,370	170,839	135,869
Copper in alloys	246,500	167,400	[1] 348,330	[1] 361,207	[1] 590,527
Total secondary copper	532,100	359,800	499,700	532,046	726,396
From new scrap	123,200	92,500	212,800	198,156	313,697
From old scrap	408,900	267,300	286,900	333,890	412,699
Percent of domestic mine output	63	65	69	61	76

[1] Includes copper in chemicals as follows: 1939, 3,200 tons; 1940, 9,431 tons; 1941, 9,804 tons.

CONSUMPTION AND USES

NEW SUPPLY

The usual discussion on supplies of new copper available for domestic use can be given in general terms only. This condition is due to the fact that precise information in 1941 regarding additions to supply by importation and withdrawals from supply for exportation are

available for the first 9 months of the year only; data for the last quarter are confidential. A tremendous gain in imports and a severe drop in exports, however, are shown by the 9-month totals. Enough data are at hand to indicate that new copper was withdrawn from supply for domestic consumption in 1941 at a considerably higher rate than ever before. The record consumption, of course, was a direct result of the present World War, in which, however, the United States did not become an active participant until December 1941. The entry of this country into the war and the successive announcements of new and larger armament plans foretell new consumption records in 1942 and 1943. The recording of these tonnages as domestic consumption is accurate only insofar as consumption applies to the use of refined copper and primary fabricated shapes. Much of the metal, particularly in 1940 and 1941, actually was used in foreign countries, for after its manufacture here into war and industrial products it was or will be shipped abroad.

The following table shows the computation of apparent domestic consumption of new copper for 1937 to 1940. It should be noted that exports and stocks include some refined secondary copper that cannot be determined separately and that actual consumption of new copper would differ from the figures shown in the table by the changes in consumers' stocks.

New refined copper withdrawn from total year's supply on domestic account, 1937–41, in pounds

	1937	1938	1939	1940	1941
Total supply of new copper	2,148,602,618	1,588,434,754	2,051,558,228	2,763,786,187	(1)
Stock at beginning of year	220,000,000	358,000,000	362,000,000	191,000,000	183,000,000
Total available supply	2,368,602,618	1,946,434,754	2,413,558,228	2,954,786,187	(1)
Copper exported [2]	620,791,029	770,446,945	792,812,995	754,215,509	[3] 155,648,305
Stock at end of year	358,000,000	362,000,000	191,000,000	183,000,000	155,000,000
	978,791,029	1,132,446,945	983,812,995	937,215,509	(1)
Withdrawn on domestic account	1,389,811,589	813,987,809	1,429,745,233	2,017,570,678	(1)

[1] Bureau of Mines not at liberty to publish, owing to confidential nature of foreign trade figures for last 3 months of year.
[2] Includes refined copper in ingots, bars, rods, or other forms.
[3] Figures cover January to September, inclusive.

INDUSTRIAL USE OF COPPER

The annual figures of the American Bureau of Metal Statistics on consumption of copper, by uses, for 1937 to 1941, inclusive, are shown in the following table. No other similar data are available in as complete detail. Figures for 1941 confirm the indications that consumption in that year towered above all previous annual totals—it was 50 percent above 1940 and 38 percent above the previous record established in prosperous 1929. Before the war began in 1939, the possibility of again equaling the 1929 record appeared to be reserved for the very distant future. The magnitude of the program for tanks, ships, and airplanes, among other things, quickly changed previous ideas regarding requirements for copper.

The American Bureau of Metal Statistics Year Book states that the absence of information as to uses by arsenals, navy yards, and

shipbuilding yards, and on exports of manufactures (except for the first 9 months of the year) makes it impossible to supply 1941 estimates for all lines. The Year Book says—

The total deliveries of refined copper into consumption in the United States in 1941 (as to which we regard deliveries for manufactures for export as for domestic consumption) were 1,605,000 tons in shipments ex copper and brass mills, wire and cable mills, and in consignments to foundries for the manufacture of brass castings. It does not follow that this delivery passed into use and probably it did not.

Estimated use of copper in the United States, 1937–41, in short tons

Use	1937	1938	1939	1940	1941
Electrical manufactures [1]	212,000	150,000	185,000	247,000	393,000
Telephones and telegraphs	40,000	30,000	39,000	49,000	78,000
Light and power lines [2]	83,000	62,000	67,000	74,000	94,000
Wire cloth	6,800	6,000	8,000	9,200	13,000
Other rod and wire [3]	102,000	60,000	95,000	120,000	253,000
Automobiles [4]	112,000	55,000	85,000	103,000	112,000
Buildings [5]	70,500	67,500	89,000	102,000	134,000
Castings, n. e. s. [6]	40,000	31,000	33,000	35,000	38,000
Clocks and watches	4,000	3,000	4,000	4,400	4,400
Copper-bearing steel	4,600	2,600	4,200	4,700	4,900
Radiators, heating	2,100	2,000	3,600	2,900	480,700
Radio receiving sets	23,100	21,000	27,000	32,000	
Railway equipment [7]	7,100	1,700	2,700	5,700	
Refrigerators [8]	13,500	6,700	10,000	10,500	
Shipbuilding [8]	6,400	6,000	8,500	8,700	
Air conditioning [8, 9]	7,200	6,000	6,000	6,000	
Ammunition	14,100	12,500	14,500	26,000	
Other uses [10]	66,600	46,200	67,600	81,500	
Manufactures for export	45,000	38,800	51,900	148,400	
	860,000	608,000	801,000	1,070,000	1,605,000

[1] Generators, motors, electric locomotives, switchboards, light bulbs, etc.
[2] Transmission and distribution wire and bus bars, accounting only for public-utility companies.
[3] Includes industrial wire and cable, wire in buildings, railway cars and ships, radio broadcasting, railway and municipal signaling, railway electrification, trolley wire, rod and wire for Government projects, blasting wire, flexible cord, and sundries.
[4] Does not include starter, generator, and ignition equipment.
[5] Excludes electrical work.
[6] Bearings, bushings, lubricators, valves, and fittings.
[7] Includes air conditioning.
[8] Excludes electrical equipment.
[9] Other than railway.
[10] Includes condenser tubes, oil-burner tubing, welding rod, screw-machine products, nickel-silver and phophor-bronze products, rivets and burrs, toilet pins, eyelets and grommets, electrotyping and engraving sheet, spark plugs, inner-tube valve stems, jar tops and rouge boxes, flashlight tubes, kerosene lamps, kitchen utensils, kitchen-range boilers, linotype matrices, safety razors, blasting caps, asbestos textiles, water meters, thermostats, soldering coppers, yacht fittings, coinage, washing machines, household water heaters, fire extinguishers, pumps, airplanes, engines, and sundry machinery, etc., all reckoned in terms of copper content.

STOCKS

The following table gives domestic stocks of copper as reported by primary smelting and refining plants. Stocks of blister and anode copper in transit from smelters to refineries are included under blister copper.

Stocks of copper at primary smelting and refining plants in the United States at end of year, 1937-41, in pounds

Year	Refined copper	Blister and materials in process of refining [1]	Year	Refined copper	Blister and materials in process of refining [1]
1937	358,000,000	428,000,000	1940	183,000,000	486,000,000
1938	362,000,000	466,000,000	1941	155,000,000	479,000,000
1939	191,000,000	520,000,000			

[1] Includes copper in transit from smelters in the United States to refineries therein.

Inventories of refined copper at primary refineries in the United States at the end of 1941 were 15 percent below 1940 and were the smallest recorded since 1928. The demand that carried stocks to 114,000,000 pounds at the close of 1928, however, was the industrial boom of that period and varied greatly from the requirements for the war expansion program of 1941. Stocks of blister and anode copper at smelters, in transit to refineries, and at refineries at the end of 1941 were only slightly lower than in 1940 and, on the whole, were of relatively the same size as inventories of this class for a number of years.

Figures compiled by the Copper Institute and published in the press show that domestic stocks of refined, duty-free copper totaled 75,564 tons at the close of 1941 compared with 142,772 tons in 1940. Study of the monthly changes in stocks in 1941 fails to reveal a complete story, inasmuch as free movement of metal was impossible during more than half of the year. The low point of the year in stocks occurred at the end of September, when 63,670 tons were reported. Differences are always found between stock data supplied by the Bureau of Mines and those of the Copper Institute and are due partly to a somewhat different coverage and to an arbitrary but permissible method used by the Copper Institute in designating the copper as domestic or foreign metal. Exceptional conditions in the market during 1941 brought the two sets of figures for the end of that year into closer agreement than usual.

Fabricators' statistics in 1941, published in the press, clearly show the effects of the tremendous demands for copper in that year. Stocks of refined copper in fabricators' hands fell from 339,755 tons at the end of 1940 to 292,973 tons at the end of 1941. Meanwhile, unfilled purchases of refined copper by fabricators from producers were 326,269 and 241,335 tons, respectively. Fabricators' working stocks, which rise and fall according to plant activity, were 237,105 tons on December 31, 1940, and 291,515 tons on December 31, 1941. Unfilled sales by fabricators to customers rose from 413,388 to 547,468 tons, respectively, at the close of 1940 and 1941. The excess of fabricators' stocks over booked orders declined from 15,531 tons at the end of 1940 to —304,675 tons at the end of 1941; this position had worsened further to —425,286 tons by the end of April 1942. Unfilled orders at the end of April 1942 had reached the staggering total of 632,474 tons.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 1,139,000 short tons of copper were delivered to domestic and foreign purchasers (excluding deliveries to the Metals Reserve Co.) in 1941 at an average price (f.o.b. refinery) of 11.8 cents a pound, compared with 11.3 cents in 1940, 10.4 cents in 1939, and 9.8 cents in 1938.

Average quoted prices for 1940 and 1941 were almost identical with the delivered prices of the Bureau of Mines, each showing an increase of ½ cent a pound in 1941. The two sets of figures are

commonly in slight disagreement, owing to the fact that one is upon a sales basis and the other upon a delivery basis. Moreover, Bureau of Mines compilations of average values are computed upon the basis of weighted deliveries, whereas trade quotations are averages of averages.

Throughout the year primary producers maintained a price for electrolytic copper (delivered Connecticut Valley points) of 12 cents a pound. For much of the year their action was voluntary, in deference to wishes of the Price Administrator that a uniform 12-cent price for copper be maintained. On August 12, however, a ceiling of 12 cents a pound, Valley, was placed on copper by the Office of Price Administration, and it has continued in effect beyond the time this report was prepared (June 1942). The 12-cent ceiling applied to electrolytic-grade copper in the shape of wire bars or ingot bars delivered in carlots. Lake copper, which had previously sold at a slight premium, was placed upon the same basis as electrolytic at Connecticut Valley points. A top price of 11¾ cents a pound, Valley, was set for casting copper made by fire-refining to a standard of 99.5 percent pure, including silver as copper. The casting-copper ceiling was revised to 11¾ cents, f. o. b. refinery, early in September.

Premiums ranging from ¾ cent to 2 cents a pound were allowed for less-than-carlots sold by other than refiners or producers.

The price order exempted sales of copper to the Metals Reserve Co. This provision was made to permit the purchase by that organization of high-cost copper production at higher than ceiling prices. Other provisions referred to other kinds, grades, shapes, or forms, to contracts entered into prior to the order, and to other items.

Later in 1941 the Price Administrator announced that the proposed sale of high-cost Michigan copper to the Procurement Division of the Treasury Department at 1 cent a pound above "out-of-pocket" costs was undertaken with the full knowledge of his agency. Contracts were signed subsequently. An amendment issued January 14, 1942, provided, among other things, that sale above ceiling levels could be made to any Government department, agency, or corporation previously approved in writing by the Office of Price Administration.

Commodity Exchange, Inc., informed the Office of Price Administration and Civilian Supply that with electrolytic copper selling at no more than 12½ cents, Connecticut Valley, the proper relative price for "Standard" copper on the futures market should be approximately 11½ cents. The price agency announced on May 5 that the Commodity Exchange had agreed not to permit the opening up of new positions in the futures market for "Standard" at prices higher than 11½ cents.

The board of governors of Commodity Exchange, Inc., suspended copper trading on July 22 until further notice. This action was attributed to the allotment and priorities orders and regulations of the Office of Production Management in connection with the sale and distribution of copper, which prevented copper deliveries being freely made against Exchange contracts.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States and for spot copper at London,[1] 1940–41, in cents per pound

Month	1940			1941		
	Domestic f. o. b. refinery [2]	Domestic f. o. b. refinery [3]	Export f. o. b. refinery [3]	Domestic f. o. b. refinery [2]	Domestic f. o. b. refinery [3]	Export f. o. b. refinery [3]
January	12.09	11.954	11.999	11.87	11.819	10.257
February	11.28	11.148	11.471	11.87	11.794	10.414
March	11.26	11.160	11.407	11.87	11.814	10.592
April	11.20	11.087	11.258	11.87	11.820	10.952
May	11.20	11.079	11.191	11.87	11.815	10.950
June	11.25	11.128	11.216	11.87	11.810	10.950
July	10.69	10.564	10.189	11.87	11.812	10.950
August	10.83	10.708	9.851	11.87	11.778	10.950
September	11.41	11.296	9.849	11.87	11.775	11.027
October	11.87	11.826	10.436	11.87	11.775	11.367
November	11.87	11.800	10.084	11.87	11.775	11.200
December	11.87	11.802	10.293	11.87	11.775	11.200
Average for year	11.40	11.296	10.770	11.87	11.797	10.901

[1] London Metal Exchange dealings suspended for duration of war.
[2] As reported by American Metal Market Co.
[3] As reported by Engineering and Mining Journal.

Average yearly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States and for spot copper at London, 1932–41, in cents per pound

	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941
Domestic f. o. b. refinery [1]	5.67	7.15	8.53	8.76	9.58	13.27	10.10	11.07	11.40	11.87
Domestic f. o. b. refinery [2]	5.555	7.025	8.428	8.649	9.474	13.167	10.000	10.965	11.296	11.797
Export f. o. b. refinery [2]	(3)	6.713	7.271	7.538	9.230	13.018	9.695	10.727	10.770	10.901
London spot [2] [4]	5.629	6.877	7.496	7.753	9.4[illegible]	13.097	9.912	[5]10.066	(6)	(6)

[1] As reported by American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Not available. Export quotation established after imposition of tariff in 1932
[4] Conversion of English quotations into American money based on average rates of exchange recorded by Federal Reserve Board of Treasury.
[5] Average for 8 months
[6] No quotations.

With the market under strict controls, totals for domestic copper sales in 1941 declined from 1940– 1,037,900 tons from 1,109,749 tons. Peak monthly sales occurred in January, when they totaled 104,835 tons, considerably less than half the 254,277 tons attained in September 1940, the highest monthly sales ever recorded.

Transactions on the London Metal Exchange were suspended at the beginning of the war. The maximum buyers' price on standard copper was fixed by the British Ministry of Supply at £62 per long ton in December 1939 and has remained there to the present.

FOREIGN TRADE [2]

Ordinarily United States imports and exports of copper constitute a well-balanced trade through which the smelting, refining, and manufacturing facilities of this country are utilized to treat foreign raw materials and to return copper and manufactures of copper abroad. Normal trade conditions are nonexistent at present (June

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

1942), and many of the avenues of trade are greatly changed. Nonetheless, record-breaking quantities of copper entered the United States in 1941, and large amounts were exported. Exports, however, were in even further stages of manufacture than usual—forms not covered by this report—and they were highly concentrated, no doubt, among what are now the Allies of the United States. For more than a year, the accent in the United States has been on obtaining increased quantities of crude and refined copper for its own expanded needs and for the manufacture of forms suitable for the war needs of nations fighting the Axis Powers.

Beginning with October 1941 all foreign trade information has been held confidential, so data for 9 months only are published in this report. The quantity of crude and refined copper entered during the 9 months, however, was large enough to top all previous annual totals. Meanwhile, exports of refined copper and primary fabricated shapes had declined so far that they were almost the smallest of the century, surpassing the totals for 1933, 1932, and 1901 only.

In 1941 (9 months), 58 percent by weight of the copper imported was contained in ore, concentrates, and unrefined furnace products, and 42 percent was refined copper. These proportions marked an important change from the pre-war years since enactment of the tariff in 1932, when little refined copper was entered. Less than 1 percent of the copper imported in unmanufactured form during 1938 (only 5 percent during 1939) was refined copper. It had become evident by 1940 that metal available in the United States would be inadequate to fill industrial requirements in this country, plus the sharply expanded demands of foreign countries for war products made to a large or small extent of copper. The ratio of refined imports to the total rose to 14 percent in 1940 and, as already pointed out, to 42 percent in 1941. Most of the refined copper brought into the country during 1941 was metal contracted for by the Metals Reserve Co., as mentioned in the opening section of this report.

Virtually all the copper exported is composed of refined metal and primary fabrications therefrom; 97 percent of the total for the first 9 months of 1941 consisted of such forms.

Separation of total exports to show the quantity of domestic copper shipped from the United States is not possible. From enactment of the present tariff until 1940, total exports of refined copper and primary fabricated shapes exceeded imports of unmanufactured copper. In 1940, however, the import excess was 127,000,000 pounds and for the first 9 months of 1941 reached the enormous total of 834,000,000 pounds. The apparent import excess would be reduced substantially if data were available covering copper contained in exports of such manufactured products as airplanes, tanks, and electrical apparatus.

IMPORTS

Although data in 1941 for only 9 months are available for publication, the establishment of a new high record for imports of unmanufactured copper in that year is evident, as imports for 9 months were 7 percent above the previous annual peak in 1940. The main reason for this sharp increase is the enormous gain in receipts of refined copper from Chile. For a number of years before 1940, entries of refined copper comprised no more than 5 percent of the total, but

they represented 42 percent in the first 9 months of 1941. This shift was due to the unprecedented requirements for copper in the United States in 1941 and to the disrupted state of ocean transportation; both of these caused the United States to absorb metal that normally would have been exported to Europe. Other trends are not so evident from the incomplete import figures. Conservation of cargo space probably caused a drop in receipts of ore and resulted in no increase, at least, in receipts of concentrates. Imports of ores, concentrates, and blister copper from British Africa decreased notably in 1941, but imports of crude copper from Belgian Congo appeared to have more than held their own. Canada increased its shipments of both crude and refined copper to the United States. Incomplete data indicate that receipts of concentrates from Newfoundland and blister copper from Peru declined notably in 1941.

Copper (unmanufactured) imported into the United States in 1941 (January to September, inclusive), by countries, in pounds [1]

Country	Ore (copper content)	Concentrates (copper content)	Regulus, black or coarse copper, and cement copper (copper content)	Unrefined black blister and converter copper in pigs or converter bars	Refined in ingots, plates, or bars	Old and scrap copper, fit only for remanufacture, and scale and clippings
Africa, British:						
Union of South		237,637	20,000			30,000
Other South		862,838		13,274,700		
Argentina	4,414	44,027	232,576			
Australia	1,409,953		1,993			
Belgian Congo			63,072,888	54,999,529		
Bolivia	381,077	8,911,475				
Burma			2,113,044			
Canada	159,992	50,075,664	480,718	40,560,121	7,794,119	2,732,561
Chile	2,322,250	2,794,050	3,518	202,239,445	433,729,456	89,412
Colombia	20,131	23,832				8,910
Cuba	218,142	12,575,748				
Curaçao (NWI)						104,522
Ecuador	141,532	4,685,436				
Honduras		271,280				
Mexico	1,622,733	10,584,951		64,211,741		100,942
Newfoundland and Labrador		9,963,109				9,138
Panama, Republic of						66,550
Peru	458,490	5,327,344		46,937,217		66,430
Philippine Islands	(2)	[3]3,853,129				
Other countries	5,425	24,482	7,455			82,444
	6,744,139	110,235,002	65,932,192	422,222,753	441,523,575	3,290,909

[1] Data include copper imported for immediate consumption plus material entering country under bond.
[2] Some copper in "ore" and "other" from Philippine Islands not separately classified is included under "concentrates."

Copper (unmanufactured) imported into the United States, 1937–41, by countries, in millions of pounds [1]

Country	1937	1938	1939	1940	1941 (Jan.–Sept.)
Africa:					
Belgian Congo				122	118
British:					
Union of South	1	4	34	32	(2)
Other South	4	9	30	55	14
Australia	5	5	6	2	1
Bolivia	6	5	4	8	9
Canada	61	88	95	103	102
Chile	199	135	240	409	641
Cuba	28	36	20	23	13
Ecuador	(2)	(2)		3	5
Malta, Gozo, and Cyprus Islands	9	3	3	9	
Mexico	108	94	105	87	77
Newfoundland and Labrador	16	13	20	20	10
Peru	82	80	77	84	53
Philippine Islands	1	3	3	4	4
Turkey		5	11	12	
United Kingdom	2	1	1	(2)	(2)
Yugoslavia	32	21	19		
Other countries	6	2	5	10	3
	560	504	673	983	1,050

[1] Data include copper imported for immediate consumption plus material entering country under bond.
[2] Less than one-half million pounds.

Copper (unmanufactured) imported [1] *into the United States, 1937–41*

Year	Pounds	Year	Pounds
1937	559,749,133	1940	982,684,647
1938	504,327,779	1941 (Jan.–Sept.)	1,049,948,570
1939	672,594,122		

[1] Data include copper imported for immediate consumption plus material entering country under bond.

EXPORTS

Total exports of copper as refined metal and in primary fabricated shapes slumped sharply, according to the incomplete foreign trade data available for publication for 1941; they were surpassed by all but 3 years of the present century. The foregoing statement gives a partial picture only, because huge demands for manufactured products that contain copper caused the shipment of considerable but unknown quantities of this metal from the United States.

Comparison of export data for the first 9 months of 1941 with those for the similar period of 1940 reveals some drastic changes. The largest export class—refined copper in ingots, bars, etc.—declined 78 percent during the 1941 period. Other important decreases were 52 percent for pipes and tubes, 41 percent for rods, and 37 percent for old and scrap. Plates and sheets moved against the general trend and increased 7 percent. Bare-wire exports were 30 percent lower during the first 9 months of 1941 than in the same months of 1940, and rubber-covered wire was 68 percent lower. Weatherproof wire, however, gained 30 percent in the 9-month period of 1941 and the vastly more important "other insulated wire," 84 percent.

Information concerning the destination of exports in 1941 has been published for only the first 3 months of the year. It is a noteworthy and bitter fact that from 1937–40, inclusive, Japan received more of the copper shipped from the United States than did any other country. This movement was halted in 1941, but not before large quantities of metal had been sent to Japan. Germany, France, Italy, and other European countries normally were markets for large quantities of United States copper but naturally are receiving none at present. The United Kingdom was the destination of the second-largest amount in 1940 and doubtless outranked all other countries in 1941.

In recent years, exports of copper and primary manufactures thereof to Brazil and Argentina have increased. Shipments to China gained notably in 1940 and continued to be large during the first 3 months of 1941.

The second table following shows the destinations of copper exported in 1937 to 1940, inclusive, and in the first 3 months of 1941.

Copper exported from the United States, 1937–41, by classes

Class	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore, concentrates, etc (copper content)	8, 175, 174	$891, 639	2, 004, 229	$171, 878	123, 839	$24, 644
Refined in ingots, etc	590, 127, 046	76, 684, 278	741, 090, 681	74 062, 534	745, 554, 651	82, 232, 831
Old and scrap	41, 828, 050	4, 571, 368	43 621, 346	3, 574 704	35, 285, 656	3, 375, 608
Pipes and tubes	2, 182 976	547, 363	1, 644, 804	355, 368	3, 139, 888	746, 833
Plates and sheets	2, 770, 814	584, 294	1, 099 590	224, 466	1, 685, 218	353, 280
Rods	30, 663, 983	4, 113, 564	29, 356, 264	3, 127, 467	47, 258, 344	5, 489, 481
Wire (bare)	9, 389, 653	1, 521, 911	10, 723, 595	1, 285, 951	7, 259, 770	997, 698
Insulated copper wire and cable						
Rubber-covered	7, 705, 486	2, 046, 995	6 055, 254	1, 389, 762	5, 875, 757	1, 302, 735
Weatherproof	2, 615, 497	473, 541	2, 598, 495	398, 924	2 644, 200	413, 264
Other	5, 174, 582	1, 339, 817	5, 833, 168	1, 528, 994	6, 330, 330	1, 384, 991
Other copper manufactures	(1)	851, 697	(1)	689, 008	(1)	863, 561

Class	1940		1941 (Jan -Sept)	
	Pounds	Value	Pounds	Value
Ore, concentrates, etc (copper content)	588, 546	$79, 623	3, 276	$390
Refined in ingots, etc	712, 862, 128	81, 840, 805	135, 661, 707	15, 365, 393
Old and scrap	14, 297, 577	1, 526, 158	6, 402, 569	711, 265
Pipes and tubes	7, 671 798	1, 631 458	2, 921, 154	787, 482
Plates and sheets	7, 454, 072	1, 435, 438	5, 678, 425	1, 096, 288
Rods	41, 353, 381	5, 167, 363	19, 986, 598	2, 611, 735
Wire (bare)	17, 711, 322	2, 642, 572	7, 449, 882	1, 300, 905
Insulated copper wire and cable				
Rubber-covered	32, 773, 326	9, 108, 533	9, 692, 732	2, 708, 917
Weatherproof	1, 533, 064	289, 716	1 855, 562	378, 204
Other	19, 642, 743	4, 812 551	25, 937, 025	6, 179, 516
Other copper manufactures	(1)	1, 584, 441	(1)	1, 007, 995

[1] Quantity not recorded.

Copper exported from the United States, 1937–40 and January to March 1941, by countries, in millions of pounds

Country	1937	1938	1939	1940	1941 (Jan.–Mar.)
Argentina	7	6	4	11	1
Belgium	34	22	14	3	------
Brazil	5	5	8	12	3
Canada	7	4	2	4	2
China	12	4	3	14	5
Cuba	3	2	3	3	(1)
Czechoslovakia	12	70	2	------	------
Denmark	7	5	7	3	------
Finland	6	9	7	5	------
France	84	70	153	73	------
Germany	100	173	54	------	------
Hong Kong	6	8	(1)	1	(1)
Hungary	(1)	3	10	10	------
India, British	9	5	11	14	6
Indochina, French	(1)	(1)	11	1	(1)
Italy	42	47	60	68	------
Japan	157	222	259	241	43
Kwantung	2	9	17	20	4
Mexico	8	3	4	7	2
Netherlands	20	21	16	8	------
Norway	8	6	12	1	------
Philippine Islands	3	4	3	3	1
Poland and Danzig	7	25	25	------	------
Spain	(1)	(1)	1	2	(1)
Sweden	35	39	51	13	(1)
Switzerland	(1)	1	7	15	------
U S S R	4	(1)	49	115	2
United Kingdom	108	62	45	163	15
Other countries	15	19	17	46	9
	701	844	855	856	93

[1] Less than one-half million pounds

Copper [1] exported from the United States, 1937–41

Year	Pounds: Metallic [2]	Pounds: Total	Total value	Year	Pounds: Metallic [2]	Pounds: Total	Total value
1937	692,458,087	700,633,261	$92,774,770	1940	855,299,411	855,887,957	$108,534,217
1938	842,023,197	844,027,426	86,119,848	1941 [3]	215,585,654	215,588,930	31,140,095
1939	855,033,814	855,157,653	96,321,365				

[1] Exclusive of "other copper manufactures" valued at $851,697 in 1937, $689,008 in 1938, $863,561 in 1939; $1,584,441 in 1940; and $1,007,995 in 1941 (Jan. Sept.)

[2] Exclusive of ore, concentrates, and composition metal, exclusive also of unrefined copper, figures for which are not separable from those for ore and concentrates

[3] January to September, inclusive

The value of brass and bronze exported from the United States gained sharply in 1940, when it was five times that in 1939. It declined in 1941; but the total for the first 9 months was larger than any annual total (except 1940) since 1918. Data covering this class, too, are incomplete for publication, but the figures that may be published indicate that the drop in 1941 was shared by all major classes of brass and bronze.

Brass and bronze exported from the United States, 1940-41, by classes

Class	1940		1941 (Jan.-Sept.)	
	Pounds	Value	Pounds	Value
Ingots	1,347,729	$188,039	161,908	$24,086
Scrap and old	11,774,885	1,056,414	1,361,873	104,713
Bars and rods	63,179,616	8,894,520	14,623,767	2,487,924
Plates and sheets	117,287,133	21,719,237	55,773,337	10,098,695
Pipes and tubes	4,267,606	1,149,321	2,181,833	666,179
Pipe fittings and valves	2,944,804	1,786,549	2,037,547	1,330,938
Plumbers' brass goods	1,424,883	796,402	916,086	537,987
Wire of brass or bronze	9,312,705	2,686,117	5,879,195	1,451,026
Brass wood screws	(1)	72,929	(1)	88,061
Hinges and butts of brass or bronze	(1)	98,721	(1)	97,349
Other hardware of brass or bronze	(1)	371,646	(1)	372,917
Other brass and bronze manufactures	(1)	6,408,879	(1)	3,510,195
		45,228,774		20,770,070

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1937-41

[Ingots, bars and rods, and plates and sheets]

Year	Pounds	Value	Year	Pounds	Value
1937	17,373,035	$2,573,245	1940	181,814,478	$30,801,796
1938	3,645,637	677,809	1941 (Jan.-Sept.)	70,559,012	12,610,705
1939	12,951,892	1,946,578			

Copper sulfate (blue vitriol) exported from the United States, 1937-41

Year	Pounds	Value	Year	Pounds	Value
1937	23,528,240	$1,212,430	1940	55,480,646	$2,293,983
1938	31,249,735	1,229,317	1941 (Jan.-Sept.)	47,484,360	1,952,120
1939	29,239,575	1,157,498			

WORLD ASPECTS OF COPPER INDUSTRY

Nothing much can be added to the world discussions given in chapters of this series for several preceding years, as few new data on foreign sources have been made available. The year 1941 witnessed extension of German control over European sources (with Russia the principal exception) of copper and other materials, and authorities testified to Germany's inadequacy as regards copper at least. The more surprising deficiency in copper supplies, however, was that of the United States, which has huge reserves of its own and has access to additional large sources in the Western Hemisphere and elsewhere but whose consumption for nonessential use had to be drastically curtailed to conserve metal for war requirements. The stringent situation in the United States resulted primarily from efforts of this country to fulfill its promise to serve as the arsenal of democracy. The United States did not enter the war until December. However, other democratic powers, chiefly the British Empire, made enormous demands on the United States for supplies of war materials.

Available data on foreign countries are shown in the following pages.

World mine and smelter production of copper, 1938–41, in metric tons

[Compiled by B B. Waldbauer]

Country	Mine 1938	Mine 1939	Mine 1940	Mine 1941	Smelter 1938	Smelter 1939	Smelter 1940	Smelter 1941
North America:								
Canada	259,113	276,157	(1)	(1)	[2] 215,732	[2] 229,367	281,226	(1)
Cuba	14,431	9,964	[3] 10,500	9,838	---	---	---	---
Mexico	41,851	41,390	37,602	48,716	37,100	39,045	31,252	40,914
Newfoundland	8,056	10,311	9,426	5,007	---	---	---	---
United States	595,901	660,717	796,582	869,211	[4] 570,773	[4] 698,323	[4] 922,364	[4] 1,015,346
	829,442	1,001,569	(1)	(1)	823,605	966,735	1,234,842	(1)
South America:								
Bolivia	[5] 2,885	[5] 4,056	[5] 6,660	[5] 7,274	---	---	---	---
Brazil	15	14	(1)	(1)	---	---	---	---
Chile	351,482	339,173	352,010	(1)	237,508	321,591	336,861	453,594
Peru	37,529	35,616	43,965	35,378	35,741	31,115	33,584	[3] 28,162
	391,911	378,859	(1)	(1)	373,249	358,706	370,445	481,756
Europe:								
Belgium	---	---	---	---	[6] 81,460	[6] 65,850	(1)	(1)
Bulgaria	64	320	560	(1)	---	---	---	---
Cyprus	29,789	24,384	(1)	(1)	---	---	---	---
Finland	12,232	11,797	[7] 20,000	(1)	11,824	13,246	(1)	(1)
France	[7] 600	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Germany [3] [7] / Austria [3] [7]	30,000	30,000	35,800	(1)	[8] 70,000	[8] 66,000	(1)	(1)
Hungary	336	(1)	(1)	(1)	---	---	---	---
Italy	[7] 1,000	(1)	(1)	(1)	2,963	(1)	(1)	(1)
Norway	21,619	20,358	[3] 20,000	(1)	10,547	[3] 10,515	[7] 7,250	(1)
Portugal	4,884	(1)	(1)	(1)	---	---	---	---
Rumania	[9] 580	(1)	(1)	(1)	580	(1)	(1)	(1)
Spain	[7] 30,000	(1)	(1)	(1)	14,984	[7] 7,300	4,493	(1)
Sweden	9,289	9,610	(1)	(1)	10,668	11,076	[7] 12,500	(1)
U. S. S. R [10]	[11] 114,552	[11] 114,000	[11] 157,000	(1)	114,552	144,000	157,000	(1)
United Kingdom	37	(1)	(1)	(1)	7,200	[7] 4,000	[7] 4,[illegible]	(1)
Yugoslavia	49,500	64,200	(1)	(1)	41,993	41,658	[3] 42,951	(1)
	304,473	(1)	(1)	(1)	366,771	(1)	(1)	(1)
Asia:								
Burma	[7] 3,600	[7] 3,365	(1)	(1)	---	---	---	---
China [12]	240	1	(13)	[14] 163	240	1	(13)	[14] 163
India, British	[7] 5,600	(1)	(1)	(1)	5,416	6,640	[3] 6,900	(1)
Japan:								
Japan Proper	[11] 102,000	[7] [11] 104,000	[7] [11] 125,000	(1)	102,000	[7] 104,000	[7] 125,000	(1)
Taiwan	[7] 4,000	[7] 4,000	[7] 4,000	(1)	---	---	---	---
Netherlands Indies	93	91	(1)	(1)	---	---	---	---
Philippine Islands	4,435	7,496	9,259	[7] 9,900	---	---	---	---
Turkey	[11] 2,488	[11] 5,917	[11] 8,731	(1)	2,488	5,917	8,731	(1)
U S S R	(10)	(10)	(10)	(10)	(10)	(10)	(10)	(10)
	[10] 122,456	(1)	(1)	(1)	[10] 110,144	[10] 116,558	(1)	(1)
Africa:								
Algeria	22	(1)	(1)	(1)	---	---	---	---
Belgian Congo	[11] 123,943	[11] 122,649	[11] 148,619	(1)	123,943	122,649	148,619	[7] 165,000
Rhodesia:								
Northern	254,904	(1)	(1)	(1)	216,450	215,065	[7] 231,330	(1)
Southern	5	(1)	(1)	(1)	---	---	---	---
South-West Africa	4,828	3,530	1,485	(1)	---	---	---	---
Union of South Africa	11,305	10,998	13,350	(1)	13,468	14,089	17,021	(1)
	395,007	(1)	(1)	(1)	353,861	351,803	(1)	(1)
Oceania: Australia	19,758	19,800	(1)	(1)	17,372	20,219	22,680	(1)
	2,063,000	(1)	(1)	(1)	2,015,000	[7] 2,182,000	(1)	(1)

[1] Data not available.
[2] Copper content of blister produced.
[3] According to Year Book of American Bureau of Metal Statistics.
[4] Smelter output from domestic and foreign ores, exclusive of scrap Production from domestic ores only, exclusive of scrap, was as follows 1938, 510,133 tons, 1939, 646,524 tons, 1940, 824,703 tons, 1941, 876,101 tons
[5] Copper content of exports
[6] Figures represent blister copper only In addition to blister copper, Belgium reports a large output of refined copper which is not included above as it is believed produced principally from crude copper from Belgian Congo and would therefore duplicate output reported under the latter country.
[7] Approximate production.
[8] Exclusive of material from scrap.
[9] Smelter output from ores
[10] Output from U S. S. R. in Asia included under U S S. R in Europe
[11] Smelter product.
[12] Exports of ingots and slabs.
[13] Less than 1 ton.
[14] January to August, inclusive.

REVIEW BY COUNTRIES

Australia.—The pressing need for copper for defense purposes in Australia led the Commonwealth Prices Commissioner to raise the refined copper price to £86 10s. per ton in midyear as an inducement toward increased production. At about the same time, the Minister for Supply and Development appointed a committee to investigate copper and bauxite resources. Australia was reported to be partly dependent on overseas sources for copper and entirely dependent for bauxite.

Production figures are not available for 1941, but 22,680 metric tons were produced at smelters in 1940 compared with 20,219 in 1939. Output is mainly from Mount Lyell, Tasmania, and Mount Morgan, Queensland. At the annual meeting of the Mount Lyell Mining & Railway Co., Ltd., on December 12, it was stated that larger tonnages of ore were handled during the year but that, owing to lower copper content, the copper output was a little less.

The Commonwealth Government advanced £10,000 to Mount Morgan, Ltd., for the unwatering and development of the Great Fitzroy mine at Mount Chalmers near Rockhampton. The annual capacity for production was expected to be 2,000 tons. The Government also advanced £50,000 to Mount Isa Mines, Ltd., Queensland, which produces silver, lead, and zinc, so that it may develop copper ore at the mine. It was reported that annual production probably would reach 5,000 tons. Additional prospecting and development work were in progress on other parts of the continent.

Belgian Congo.—Available data on production of copper in Belgian Congo indicate a sharp increase in activity there. Smelter output was estimated at 165,000 metric tons in 1941 compared with 148,619 tons in 1940. As indicated in the preceding report of this series (Minerals Yearbook, Review of 1940, p. 108), the Belgian and British Governments reached an agreement early in 1941 for the delivery of 126,000 metric tons of copper to the United Kingdom by Union Minière du Haut Katanga. The overrunning of Belgium by the Germans had increased the quantities of Belgian Congo copper available to the British and actually made all of it available to enemies of Germany. At the annual meeting of Union Minière du Haut Katanga (May 1941), the company capacity to produce copper was reported as 200,000 tons. New prospecting was then reported to have substantially increased ore reserves. Figures covering imports of copper into the United States during the first 9 months of 1941 show that about 28,600 metric tons of regulus, black or coarse copper, and cement copper and 24,900 tons of unrefined black blister and converter copper were received from Belgian Congo during that period; data covering all of 1941 are not available for publication.

Brazil.—Occurrences of copper in Brazil and recent attempts to promote production there are described in the Foreign Minerals Quarterly of July 1941, issued by the Bureau of Mines.

Canada.—Statistics on mine production of copper in Canada are confidential for both 1940 and 1941. There seems little reason to question, however, that new annual peaks were reached each year. There were noteworthy consumption gains also in 1941, as Canadian industry assumed a larger share in supplying the increasing war needs of the British Empire for fabricated products. The Northern

Miner (Toronto) in its annual number (November 13, 1941) stated that Canada probably was now consuming one-third of its annual output. Large amounts of brass are being manufactured, the review said, and the upward trend will be increased in the current year. The annual review number of the Engineering and Mining Journal for 1941 reported that

Munitions have become the big business of the Dominion and in securing adequate supplies of nickel, copper, and zinc for war effort, along with gold that will maintain credit with the United States, the national economy has been turned over to two agencies that have absolute authority. These are the Department of Munitions and Supply, which is the supreme purchasing control, and the Wartime Prices and Trade Board, which sets prices and wages throughout the land. The Metals Controller, who is working under this closely integrated program, is the arbiter of mining.

The Dominion Bureau of Statistics reported that Canadian base-metal mines, smelters, and refineries worked to capacity during 1941. Plans to produce other metals of strategic importance, in addition to maximum outputs of copper, lead, and zinc, were in evidence.

More than half of the copper produced in Canada in 1941 probably came, as usual, from the nickel-copper mines of the Sudbury district. The principal producer in that area is The International Nickel Co. of Canada, Ltd. This company reported that war requirements dominated markets for its products during the year and that, with few exceptions, all deliveries were made in Canada, the British Empire, and the United States. In past years the company has refined the major part of its copper and exported the remainder as matte. Quebec normally ranks as the second most important Province in copper production. Noranda Mines, Ltd., is the outstanding producer, and others include Waite Amulet, Aldermac Mines, Ltd., and Normetal Mining Corporation, Ltd. All of Quebec's production is refined at Montreal East by Canadian Copper Refineries, Ltd., subsidiary of Noranda Mines, Ltd., which was operated at capacity during the year. The Britannia Mining & Smelting Co., subsidiary of the Howe Sound Co., at Howe Sound, and the Granby Consolidated Mining, Smelting & Power Co., which operates the Copper Mountain mine at Allenby, are the principal copper producers in British Columbia. Copper reserves at the Copper Mountain mine have been greatly amplified in recent years, according to the Canadian Mining Journal of September 1941. Several years ago it was reported that ore reserves might be estimated at 10,000,000 tons. At present, the journal stated, after several years of full-blast operations reserves are estimated at 17,220,729 tons, and current operations were disclosing new ore in excess of the quantity mined. The larger reserves contained an average of 1.32 percent copper, or less than was formerly estimated. Concentrates from the two British Columbia mines mentioned go to Tacoma, Wash., for smelting and refining. The copper produced in Manitoba and Saskatchewan comes from the Flin Flon mine of the Hudson Bay Mining & Smelting Co., Ltd., and the Sherritt Gordon mine of the Sherritt Gordon Mines Co., Ltd. The report of the Hudson Bay Co. for 1941 stated that production of copper, zinc, gold, and silver in that year was the highest on record. The Sherritt Gordon production, which is restricted by current milling capacity, goes to the United States under bond for treatment.

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Chile.—The urgent world need for copper for war purposes gave impetus to production in Chile and output there reached unprecedented levels in 1941; production amounted to 453,594 metric tons compared with 336,861 tons in 1940 and 396,444 tons in 1937, the previous record year. There seems little doubt that Chile, in 1941 as usual, ranked second in importance among the copper-producing countries of the world by a substantial margin, although data for Canada and Northern Rhodesia are not available.

The strain on producers to supply requirements in 1941 marked sharp reversal of the condition that prevailed early in the war period. Then Chile was virtually cut off from its principal markets in Europe, and the large, low-cost output from its mines was almost without outlet.

According to Knox,[3] engineers have been careful to speed up Chilean production and at the same time to avoid certain errors made during the first World War, when frenzied stripping of ore often left the workings so unstable that subsequent operations were hampered.

Japan tried to obtain increasingly large supplies of crude and refined copper from Chile during 1941. Action of the Metals Reserve Co. in contracting to receive most of the copper produced in Latin America not only increased supplies of this metal available to the United States but withheld them from Japan. Reports indicated that 209,403 metric tons of electrolytic copper and 195,861 tons of standard went to the United States in 1941, out of totals of 240,707 and 199,264 tons, respectively, for all countries; Japan received 12,771 and 3,403 tons. Other South American countries received increased amounts of Chilean copper in 1941—Argentina took 10,251 tons and Brazil 8,020 tons of electrolytic copper. Italy was the destination of 6,483 tons of electrolytic copper and 11,990 tons of standard copper exported from Chile in 1940 but could not obtain any in 1941.

The Chile Copper Co. produced 216,847 metric tons of copper in 1941 compared with 150,994 in 1940, and Andes Copper Co. 94,243 tons compared with 72,932; these two companies are Anaconda Copper Mining Co. subsidiaries. The Braden Copper Co. (subsidiary of the Kennecott Copper Corporation) produced 131,703 tons in 1941 compared with 109,185 tons in 1940.

Cuba.—Production of copper in Cuba totaled only 9,838 metric tons in 1941, a decline from 10,500 tons in 1940 and only two-thirds of the output of 14,431 tons in 1938, the peak period of recent years. Minas de Matahambre, Pinar del Rio Province, has been the principal copper-producing property in Cuba. The 1941 annual report of the American Metal Co., Ltd., which owns a 59-percent interest in the Matahambre mine, stated that it had been impossible for some time past to replenish ore reserves as rapidly as ore was extracted. Unless continued search resulted in the development of new ore bodies, the report continued, the mine probably would have to cease production in about a year.

Germany.—Although Germany had overrun most of Europe (except Russia) by the end of 1941 and had access to all of Europe's copper except that of Russia, additions to supply from European mines to offset losses from Germany's major sources of supply overseas were noteworthy only insofar as the Bor mine in Yugoslavia was

[3] Knox, Newton B., South America. Eng. and Min. Jour., vol. 143, No. 2, p. 67.

concerned. Germany's supplies of copper were described in the two preceding chapters of this series. Refined metal, metal products, and scrap materials requisitioned in conquered territory have made substantial though unmeasurable additions to Germany's inventories of copper. Despite these acquisitions in 1940 and 1941, however, all authorities appear to agree that copper is one of the commodities that in the long run will present a serious problem to the Axis Powers; Italy is in a worse position than Germany, and Japan as well lacks adequate sources of supply. Germany's annual deficiency in copper and the rate at which it must draw on stocks of unknown size have been subjects of much speculation. The Metal Bulletin [4] caloulated the current rate of consumption at perhaps 372,000 tons and stated that if deductions of total mine output of 120,000 tons (all accessible Europe), process scrap of 75,000 tons (calculated upon the basis of 20 percent of current output of products), imported scrap of 30,000 tons, and possible war scrap of 25,000 tons were made, an annual drain of 122,000 tons on inventories is indicated. The Mining Journal (London),[5] after estimating current quantities of copper available from every source as compared with former supplies, stated: "From whatever angle the situation is examined. one fact is evident, Germany must replace the equivalent of about 200,000 tons of imported copper (ingots, ores, etc.) to meet even peace-time annual consumption." Percy Barbour [6] stated that Hitler consumed only 1,352,700 metric tons in the 6 years 1933-38 when he was building his war machine. Barbour's article quotes figures showing that Germany, plus all other Europe, except Russia, produced 114,000 metric tons of copper in 1940 and that consumption in Germany plus all other Europe except Russia totaled 771,000 tons in 1939, the latest year for which data are available.

Mexico.—Mine production in Mexico was carried on at a high rate in 1941; the output—48,716 metric tons—was the largest annual total since 1931. In the period 1923-31, however, tonnages produced ranged from 50,062 to 86,554 tons and averaged 61,700 tons. Smelter recovery was reported as 40,914 metric tons in 1941 compared with 31,252 tons in 1940.

Northern Rhodesia.—Northern Rhodesia is another of the large copper-producing countries of the world that have been regularly establishing new annual production records. Mine data for 1940 and 1941 are confidential, but there is no reason to doubt that the uptrend continued in those years as copper was urgently needed to help fill the large war requirements of the British Empire. There have been complaints from time to time that the British excess profits tax has worked a hardship, particularly on some of the companies, and has had a somewhat deterrent effect on production. The South African Mining and Engineering Journal of January 17, 1942, stated that the mining companies in Northern Rhodesia have expanded their operations considerably so that, in spite of the pegging of the price of their product, earnings have increased substantially. It said, however, that the financial return to those who made this expansion possible has descended sharply.

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4 Metal Bulletin (London), No. 2621, August 29, 1941, pp. 4-5.
5 Mining Journal (London), vol. 215, No. 5539, October 18, 1941, p. 19.
6 Barbour, Percy E., The War-Copper Situation: Am. Metal Market, September 23, 1941, p. 3.

The principal mines were, as usual, the Roan Antelope, Rhokana, and Mufulira. The proposed expansion at Nchanga, mentioned in the Copper chapter of Minerals Yearbook, 1940, Review of 1939, has been delayed because of the war, but the company reported a satisfactory increase in the production of concentrates in its pilot plant. According to the December issue of Engineering and Mining Journal, unofficial reports from Africa state that the Northern Rhodesia copper mines are delivering their copper in shapes that save time and labor for munitions manufacturers—evidently no longer merely in ingots, cakes, and bars.

The occupation of Madagascar by the British rather than by the Axis Powers in the first half of 1942 withdrew one of the threats to shipments of Northern Rhodesia and Belgian Congo copper from African ports.

Peru.—Peru ranks second to Chile in copper production in South America, and these two countries are the only important sources on that continent at present. Production in Peru usually amounts to somewhat more than 10 percent of the total for Chile and between 1 and 2 percent of that for the world. Unlike Chile, Peru broke no records in the production of copper in 1941 and its output, therefore, fell below the usual relationship. The Cerro de Pasco Copper Corporation, largest producer in the country, is credited with an output of 28,162 metric tons in 1941 compared with 33,538 tons in 1940 and 45,353 tons in 1929. This corporation has increased its output of lead sharply in recent years and is planning larger-scale production of zinc, Other copper producers in the country include the Northern Peru Mining Co., Sociedad Minera Puquio Cocha, Cie de Mines de Huaron, Compania Minera Rescate, and Sindicato Minero Rio Palanga.

Exports of copper contained in bars, concentrates, and ores totaled 36,417 metric tons in 1941 compared with 37,686 tons in 1940.

Philippine Islands.—Japan had been receiving the major part of the copper produced in the Philippine Islands, but in the latter part of 1941 exports to Japan were virtually embargoed. As a consequence the Hixbar Gold Mining Co., second-largest copper producer, was reported to have been forced to suspend mining operations; the mine has no concentrating plant, and Japan had been the only market for the grade of ore produced. A report prepared by the American consul in April 1941 stated that production in all of 1941 probably would amount to 9,900 metric tons, or between 5 and 10 percent above that in 1940. The shut-down at Hixbar may have prevented fulfillment of this estimate. At the end of 1941, Lepanto Consolidated was reported to be the only active copper producer in the Philippines.

Following successful invasion of the Islands by the Japanese in the early part of 1942 Japan can requisition, for a time at least, the entire output of the Philippines and can dictate the reopening of idle properties if desired.

Sweden.—Swedish authorities have prepared to improve their trade balance as regards copper. The annual production is reported to be 12,500 metric tons, and an increase of some 3,000 tons is anticipated as a result of an agreement between the Government and the Boliden Mining Co.—largest producer—regarding exploitation of certain Government-owned deposits in the Province of Västerbotten.

Recent reports originating in Sweden credit annual consumption in that country with 40,000 to 45,000 tons. On April 1, 1941, the Swedish Government expropriated all stocks of copper and decreed that copper and its alloys were to be sold under license only. Substitution of other metals for copper and brass was reported to be in progress in Sweden.

Union of South Africa.—Production of copper in the Union of South Africa has increased in recent years; data for 1941 are not available, but mine output totaled 13,350 metric tons in 1940 compared with 10,998 tons in 1939. The principal producer is the Messina mine, Northern Transvaal, and operations at that property were recently described.[7] Resumption of copper mining in Namaqualand by the O'okiep Copper Co., Ltd., was mentioned in the Copper chapter of Minerals Yearbook, Review of 1940.

Figures covering imports of blister and converter copper into the United States during the first 9 months of 1941 show that 6,021 metric tons were received from British South Africa. During the same period, 499 metric tons of copper in concentrates and small quantities of regulus and scrap were received. Data covering receipts of material in all of 1941 cannot be published.

[7] South African Mining and Engineering Journal, Mining and Smelting Copper at Messina: Vol. 52, No. 2545, November 8, 1941, pp. 265-267.

LEAD [1]

By T. H. MILLER AND A. L. RANSOME

SUMMARY OUTLINE

GENERAL SUMMARY

The lead industry in 1941 was called upon to fill a growing and unprecedented demand. Lead was not only used as an essential war metal in direct military applications specified under the national defense program but as a substitute to help relieve the shortage of other nonferrous metals. As the result of this pressure, the industry showed moderate gains over 1940; but these advances were inadequate, despite the continued flow of metal into the United States from foreign sources, and by October lead was placed under Government control.

The output of refined primary lead from domestic and foreign ores was 7 percent above that in 1940 and the largest recorded since 1930. Production from domestic ores increased 9 percent, but that from foreign ores remained virtually unchanged from the high level established in 1940. The estimated industrial use of lead (primary, secondary, and antimonial) rose 34 percent and was 8 percent above the record established in 1929. As production failed to pace demand, year-end stocks at domestic refineries declined for the seventh consecutive year. This condition was balanced somewhat by a corresponding rise in consumers' inventories, which indicates that apparent consumption was greater than the amount actually used. Prices for lead at New York advanced from 5.50 cents a pound in January to 5.85 cents in April, at which point the quotation was stabilized for the rest of the year; the average price for the year increased from 5.18 cents in 1940 to 5.79 cents in 1941.

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For full details of mining operations, see separate reports issued for the various States.

Salient statistics of the lead industry in the United States, 1925–29 (average) and 1937–41, in short tons

	1925–29 (average)	1937	1938	1939	1940	1941
Production of refined primary lead:						
From domestic ores and base bullion	660,525	443,142	331,964	420,967	433,065	470,517
From foreign ores and base bullion	123,104	24,175	51,705	63,068	100,114	100,450
	783,629	467,317	383,669	484,035	533,179	570,967
Recovery of secondary lead	280,000	275,100	224,900	241,500	260,346	397,416
Imports:[1]						
Lead in pigs, bars, and old	4,592	4,903	3,235	7,139	151,568	[2] 179,179
Lead in base bullion	95,747	1,800	15,296	48,902	19,624	[2] 23,631
Lead in ores and matte	40,096	34,103	45,370	30,842	111,300	[2] 58,082
Exports of refined pig lead	98,048	20,091	45,866	74,392	[3] 49,079	[2] 13,494
Lead remaining in bonded warehouse at end of period	136,969	60,131	87,811	79,215	211,876	[4] 153,289
Refined primary lead available for consumption	690,916	449,464	339,708	415,031	633,989	([5])
Estimated consumption of primary and secondary lead	900,250	678,700	546,000	667,000	782,000	1,050,000
Prices:						
New York:						
Average for year ..cents per pound	7.47	6.01	4.74	5.05	5.18	5.79
Quotation at end of year ..do	6.25	4.75	4.85	5.50	5.50	5.85
London average ..do	5.87	5.15	3.33	[6] 3.09	([7])	([7])
Mine production of recoverable lead	664,230	464,892	369,726	413,979	457,392	461,426
World smelter production of lead	1,850,000	1,851,000	1,878,000	1,919,000	([8])	([8])

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Figures cover January to September, inclusive.
[3] Includes 25,324 tons of foreign refined lead re-exported, according to American Bureau of Metal Statistics; official figures not available.
[4] September 30.
[5] Figures not available for publication.
[6] Average for 8 months, London Metal Exchange dealings suspended for duration of war.
[7] Official maximum price fixed by British Ministry of Supply at £25 per long ton.
[8] Data not available.

Record quantities of lead continued to be received from abroad, largely in the form of refined metal principally from Mexico, but also in greatly increased tonnages from Canada, Australia, and Peru. Government stock piles of foreign lead purchased through the Metals Reserve Company were drawn on to bridge the gap between production and shipments; as a result, the large quantity of lead that had accumulated in bonded warehouses by the end of 1940 was notably depleted during the first 9 months of 1941.

Figure 1 shows trends in the domestic lead industry since 1900.

National defense activity.—All defense requirements necessitating the consumption of lead were met in 1941, including direct use in ammunition and in important indirect secondary military uses, such as batteries, paints, tetraethyl lead, and chemicals. One of the largest jobs for lead was in substitution for other metals, including aluminum, copper, zinc, and tin which were more important for war purposes and a great deal less abundant. Very little concern was felt as to lead supplies during the first part of 1941, and only nominal surveillance over the lead industry by the Production Division of the Office of Production Management was necessary. Following a previously issued warning, Leon Henderson, Commissioner of Price Stabilization of the Advisory Commission to the Council of National Defense, on April 5, 1941, requested that there be no further increase in the price of lead. This announcement, with its accompanying threat of ceiling prices, halted the upward trend, and no further change occurred during 1941.

Following the rapid expansion of lead consumption in early 1941, it was soon apparent that a shortage threatened, and, to conserve

supplies and prevent lead from getting unto unfriendly hands, the metal was placed under export control as of March 24, 1941. This order included lead in ore, matte, pigs, bars, and manufactures and on May 6 was extended to include lead pigments.

On May 1, 1941, General Metals Order 1, designed to restrict inventory accumulation of lead and various other metals not under priority control, was issued by the Office of Production Management. It remained in effect until October 4, when all supplies of lead, including domestic and imported, were placed under full priority control. The new control, provided for in Order M-38, set up a system of allocation that previously had been restricted to releases of foreign lead purchased and held by the Metals Reserve Company. An

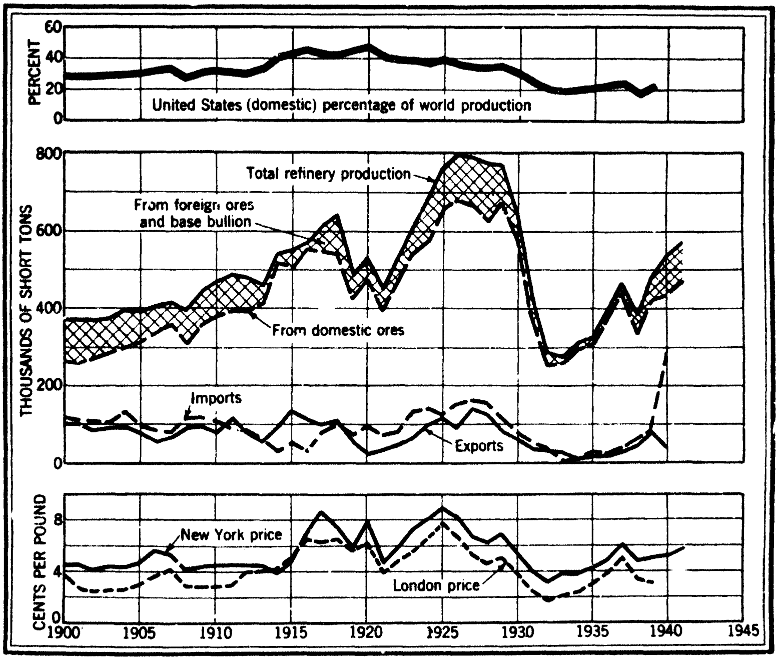

FIGURE 1.—Trends in the lead industry in the United States, 1900–1941. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back.

emergency pool was set up to take care of special needs, and on October 23 the Division of Priorities of the Office of Production Management ordered refiners of lead to set aside 15 percent of their November production for allocation from this pool. The same percentage was ordered set aside for December and for each successive month of 1942 up to the time this review was written (June 25).

In an effort to ease the supply situation, an appeal was sent to all lead producers and miners by the Office of Production Management early in November, asking them to increase production. On January 13 the Office of Production Management, jointly with the Office of Price Administration, announced a two-point program to meet the urgent additional demands for copper, lead, and zinc that followed active entry into the war. With regard to lead, the program involved an increase in the price at New York to a ceiling of 6.50 cents a pound

and a payment, through the Metals Reserve Company, of a premium price of 9.25 cents for lead produced in excess of quotas based upon 1941 output. The premium-price plan was made effective as of February 1, 1942, for 2½ years.

DOMESTIC PRODUCTION

Pig lead is produced at primary plants that treat mainly ore and at secondary plants that treat scrap exclusively. Both types of plants may produce refined lead or antimonial lead. Because of the large quantity of battery scrap treated at secondary smelters, their output comprises chiefly antimonial-lead alloys. Figures for production of refined lead at secondary plants are shown in the section on Secondary Lead.

The following table shows production of refined lead and antimonial lead at primary refineries from 1937 through 1941.

Refined lead and antimonial lead produced at primary refineries in the United States, 1937–41, in short tons

Year	Refined lead				Antimonial lead
	From domestic ores and base bullion	From foreign ores and base bullion	From scrap	Total	
1937	443,142	24,175	29,986	497,303	27,524
1938	331,964	51,705	24,800	408,469	24,123
1939	420,967	63,068	29,011	513,046	21,995
1940	433,065	100,114	16,588	549,767	29,762
1941	470,517	100,450	13,454	584,421	40,237

PRIMARY LEAD

Refinery production.—Production of refined primary lead increased 7 percent in 1941 but was only 73 percent of the 1925–29 average (783,629 tons). Output from domestic ores and base bullion gained nearly 9 percent; production from foreign ores and base bullion remained virtually unchanged, with an increase of less than 1 percent from the high level attained in 1940, and was considerably less than the average (123,104 tons) for the period 1925–29.

Refined primary lead produced in the United States, 1937–41, by classes and sources

Year	Production (short tons) by—						Total production [1]		
	Class			Source			Short tons	Value	
	Desilverized lead [1] [2]	Soft lead [3]: Desilverized	Soft lead [3]: Undesilverized	From domestic ores and base bullion	From foreign ores	From foreign base bullion		Average sales price per pound	Total calculated value
1937	272,051	55,317	139,949	443,142	23,393	782	467,317	$0.059	$55,143,000
1938	243,891	31,986	107,792	331,964	32,862	18,843	383,669	.046	35,298,000
1939	280,356	65,349	138,330	420,967	24,652	38,416	484,035	.047	45,499,000
1940	336,456	43,400	153,323	433,065	83,563	16,551	533,179	.050	53,318,000
1941	366,385	39,872	164,710	470,517	74,166	26,284	570,967	.057	65,090,000

[1] Lead content of antimonial lead excluded.
[2] Desilverized soft lead excluded.
[3] Includes lead derived from Missouri ores and other nonargentiferous ores.

Sources of primary lead.—Of the total refined primary lead produced in 1941, 82 percent was derived from domestic ores and base bullion and 18 percent from foreign. Production from foreign ores decreased 11 percent from the all-time record established in 1940, but lead refined from foreign bullion advanced 59 percent. Details of the sources of lead from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, 1936–41, by sources, in short tons

Source	1936	1937	1938	1939	1940	1941
Domestic ore and base bullion	387,698	443,142	331,964	420,967	433,065	470,517
Foreign ore:						
Australia	172	3,088	7,320	7,580	14,856	19,561
Canada	2,277	5,343	3,562	4,763	9,009	5,708
Europe	1,133	388	14	188	3,650	123
Mexico	1,486	3,836	9,745	227	1,303	390
South America	3,883	8,497	9,887	8,869	34,744	27,173
Other foreign	2,450	2,241	2,334	3,025	20,001	21,211
	11,401	23,393	32,862	24,652	83,563	74,166
Foreign base bullion:						
Mexico	57	782	18,268	37,463	16,161	25,358
South America				9		47
Other foreign			575	944	390	879
	57	782	18,843	38,416	16,551	26,284
Total foreign	11,458	24,175	51,705	63,068	100,114	100,450
Grand total	399,156	467,317	383,669	484,035	533,179	570,967

Antimonial lead.—Antimonial or hard lead is an important byproduct of the refining of base bullion, but the quantity derived from this source is only a small part of the country's yearly production. The major part is obtained from the smelting of antimonial-lead scrap, and some is produced by mixing metallic antimony with refined soft lead.

Several lead-smelting plants handle scrap materials exclusively. Production data from such plants are summarized in the following section and discussed in detail in the chapter on Secondary Metals—Nonferrous. A large quantity of hard-lead scrap also is treated at primary smelters and refineries; the production of antimonial lead at such plants is shown in the following table.

Antimonial lead produced at primary lead refineries in the United States, 1937–41

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1937	27,524	2,579	9.4	7,833	1,721	15,391	24,945
1938	24,123	2,809	11.6	6,759	3,385	11,170	21,314
1939	21,995	2,031	9.2	4,117	3,189	12,658	19,964
1940	29,762	2,944	9.9	7,364	3,023	16,431	26,818
1941	40,237	3,510	8.7	14,852	8,013	13,862	36,727

SECONDARY LEAD

As previously stated, some scrap lead is treated at primary plants, but the greater part is refined at a large number of plants that operate exclusively on secondary materials. Secondary lead is recovered in the form of refined lead, antimonial lead, other alloys, and chemicals. Recovery at primary and other plants in 1940 and 1941 is shown in the following table. Secondary lead recovered in 1941 totaled 53 percent more than in 1940 and was equivalent to 84 percent of the domestic refined primary lead output. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1940–41, in short tons

	1940	1941
As refined metal:		
At primary plants	16,588	13,454
At other plants	42,992	61,810
	59,580	75,264
In antimonial lead:		
At primary plants	16,431	13,862
At other plants	110,256	192,660
	126,687	206,522
In other alloys [1]	74,079	115,630
Grand total:		
Short tons	260,346	397,416
Value	$26,034,600	$45,305,400

[1] Includes some lead in chemical compounds.

LEAD PIGMENTS

Lead pigments manufactured in 1941 contained 273,315 tons of lead—a 28-percent increase above 1940. Of the 248,674 tons of lead in pigments derived from refined pig lead, litharge contained 45 percent, white lead 35 percent, red lead 19 percent, and sublimed lead, leaded zinc oxide, and orange mineral 1 percent. Leaded zinc oxide and sublimed lead are the principal pigments of which the lead content is derived from ores. Details of production and consumption of lead pigments are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Lead in pigments produced in the United States, 1937–41, by sources, in short tons [1]

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Ore		Metal	Total		Ore		Metal	Total
	Domestic	Foreign				Domestic	Foreign		
1937	17,363		204,961	[2] 222,451	1940	16,869		196,235	213,104
1938	12,025		163,815	175,840	1941	23,951	290	248,674	[3] 273,315
1939	15,171		200,390	215,561					

[1] Includes also lead recovered in leaded zinc oxide.
[2] Includes 127 tons from scrap.
[3] Includes 400 tons from scrap.

MINE PRODUCTION

Mine production of lead showed an advance in each group of States—Western, Central, and Eastern—but the over-all gain during 1941 was only about 1 percent. The comparatively minor increases amounted to 1,577 tons in the Western States and Alaska, 1,775 tons in the Central States, and 682 tons in the Eastern States. Lead production from Southeastern Missouri was 164,342 tons, a decline of 5,551 tons, whereas output from the Tri-State region amounted to 41,080 tons, an advance of 5,769 tons. Gains in Oklahoma and Kansas more than offset a loss from Southwestern Missouri in 1941. Idaho continued to be the leading producer in the Western States group and was followed again by Utah and Montana; output from Idaho was only a few tons more than in 1940, and production from both the other States was less. The decrease in Utah's total is explained chiefly by decreases in output from the United States & Lark property and the National Tunnel & Mines Co. property (operations ceased about September 1941), both in the Bingham district. The principal factors causing the decline in Montana were the production drop from the Jack Waite mine and the closing, in April 1941, of the Comet-Gray Eagle group. Arizona produced 15,638 tons of recoverable lead in 1941, the greatest output in the history of the State. In Colorado the production of lead was 12,574 tons and in Nevada 9,623 tons; both totals were above the 1940 figures, as was also true for New Mexico and Washington. Additional details of production by mines, districts, and States can be found in the State chapters.

Mine production of recoverable lead in the United States, 1925–29 (average) and 1937–41, by States, in short tons

State	1925–29 (average)	1937	1938	1939	1940	1941
Western States and Alaska						
Alaska	982	823	994	937	779	662
Arizona	9,743	12,354	10,571	10,771	13,266	15,638
California	2,070	1,186	495	526	1,772	3,464
Colorado	30,112	9,786	9,455	8,222	11,476	12,574
Idaho	141,610	103,711	92,177	90,981	104,834	104,914
Montana	18,871	17,957	9,327	16,555	23,036	21,259
Nevada	9,807	9,347	4,679	4,236	7,499	9,623
New Mexico	6,730	6,512	4,949	5,392	3,82z	4,668
Oregon	6	109	23	15	35	59
South Dakota	21	----	----	----	7	----
Texas	213	395	342	227	205	186
Utah	149,509	89,458	65,657	67,634	75,688	69,601
Washington	1,323	2,830	4,284	3,718	2,555	3,903
	370,997	254,468	202,953	209,214	244,974	246,551
Central States:						
Arkansas	38	40	7	----	55	11
Illinois	552	186	175	308	1,508	2,376
Kansas	26,121	16,008	15,239	13,697	11,927	14,538
Kentucky	135	89	101	87	360	282
Missouri	202,240	157,631	122,027	156,281	172,052	165,909
Oklahoma	58,306	29,840	21,004	27,720	21,240	25,021
Wisconsin	1,745	1,091	320	388	445	1,225
	289,137	204,885	158,873	198,481	207,587	209,362
Eastern States.						
New York	----	}			1,973	2,100
Tennessee	} 4,096	} 5,539	7,896	6,284	573	23
Virginia	}	}			2,285	3,390
North Carolina	----	----	4	----	----	----
	4,096	5,539	7,900	6,284	4,831	5,513
	664,230	464,892	369,726	413,979	457,392	461,426

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1937–41, in short tons

District	State	1937	1938	1939	1940	1941
Southeastern Missouri region	Missouri	153, 205	118, 870	153, 522	[1] 169, 898	164, 342
Coeur d'Alene region	Idaho	96, 505	82, 274	81, 699	95, 609	95, 529
Joplin region	Kansas, Southwestern Missouri, Oklahoma.	50, 274	39, 400	44, 176	35, 311	41, 080
Bingham	Utah	45, 233	41, 334	36, 842	37, 857	34, 512
Park City region	do	22, 417	7, 258	11, 631	19, 749	19, 094
Tintic	do	10, 198	9, 605	8, 618	6, 536	9, 424
Butte	Montana	5, 780	204	4, 708	8, 859	8, 630
San Juan Mountains	Colorado	4, 998	5, 885	4, 402	7, 323	8, 073
Pioche	Nevada	4, 759	3, 214	2, 964	5, 520	6, 822
Harshaw	Arizona	984	149	2, 287	4, 581	5, 541
Warm Springs	Idaho	4, 004	7, 370	5, 565	5, 050	5, 334
Rush Valley	Utah	6, 410	4, 619	3, 422	4, 760	4, 168
Central	New Mexico	2, 281	340	2, 941	3, 245	3, 902
Metaline	Washington	2, 644	4, 009	3, 509	2, 495	3, 819
Austinville	Virginia	(2)	(2)	(2)	[3] 2, 285	3, 390
Eagle	Montana	4, 812	4, 301	3, 252	4, 108	3, 294
Hog Heaven	do	808	1, 214	2, 767	3, 588	2, 824
Wallapai	Arizona	2, 489	4, 004	703	2, 304	2, 408
Old Hat	do	794	1, 919	1, 861	1, 908	2, 172
St. Lawrence County	New York	(2)	(2)	(2)	1, 973	2, 100
Red Cliff	Colorado	580	933	1, 137	1, 412	1, 710
Montana	Montana	218	212	293	955	1, 601
Port Hill	Idaho	519	291	1, 111	1, 837	1, 537
Smelter	Montana	1, 178	710	1, 256	1, 363	1, 527
Ophir	Utah	3, 307	2, 013	6, 050	5, 354	1, 437
Upper Mississippi Valley	Iowa, Northern Illinois, and Wisconsin.	1, 091	320	388	453	1, 345
Leadville	Colorado	2, 100	1, 222	1, 088	794	1, 112
Bisbee (Warren)	Arizona	1, 018	14	120	692	970
Banner	do					597
Cataract	Montana	1, 946	1, 326	1, 672	1, 904	355
Tombstone	Arizona	315	315	290	276	165
Flint Creek	Montana	1, 511	113	218	119	114
Tybo	Nevada	2, 439		14	27	20
Oro Blanco	Arizona	3, 864	4, 150	3, 568		1
Willow Creek	New Mexico	3, 852	4, 277	1, 800		

[1] Corrected figure.
[2] Bureau of Mines not at liberty to publish figures.
[3] Total for Virginia but almost entirely from Austinville district.

STOCKS

Producers' stocks.—Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by most refiners of secondary material who produce common lead. Foreign lead refined in the United States and entered for domestic consumption is included.

Lead stocks at end of year at smelters and refineries in the United States, 1937–41, in short tons

	1937	1938	1939	1940	1941
Refined pig lead	119, 837	102, 489	52, 783	32, 458	15, 973
Antimonial lead	9, 294	13, 413	5, 994	8, 468	4, 212
	129, 131	115, 902	58, 777	40, 926	20, 185
Lead in base bullion—					
At smelters and refineries	10, 959	18, 693	10, 337	9, 166	8, 594
In transit to refineries	2, 219	2, 339	3, 521	3, 457	2, 215
In process at refineries	14, 413	16, 690	15, 958	18, 141	17, 709
	27, 591	37, 722	29, 816	30, 764	28, 518
Lead in ore and matte and in process at smelters	52, 081	56, 332	59, 486	71, 722	51, 446
	208, 803	209, 956	148, 079	143, 412	100, 149

During 1941 the excess of shipments over production resulted in generally decreasing inventories for the year. Stocks of refined and antimonial lead at refineries, which totaled approximately 40,900 tons at the end of 1940, rose to 47,200 tons by the end of January—the peak for 1941—but this initial gain was followed by a steady drop to a low of 10,700 tons by the end of October. During the remaining 2 months, increased production more than balanced a parallel gain in shipments, but refinery inventories (which rose to about 20,200 tons at the end of 1941) were only 49 percent of those on hand at the end of 1940. Stocks of lead in ore and matte and in process at smelters, in base bullion at smelters and refineries, and in transit to and in process at refineries were 22 percent lower at the end than at the beginning of 1941.

Consumers' stocks.—In the Bureau of Mines survey of the consumption of refined soft lead in 1941 (discussed in this chapter under the heading Domestic Consumption), consumers were asked to give their stocks of the three commercial grades of refined soft lead at the beginning and end of 1941. The results obtained give for the first time an inventory picture of the consumer phase of the lead industry. The totals shown in the following table indicate a marked increase in stocks, amounting to 33 percent. Consumers' stocks gained 25,865 tons during the year and more than offset the decrease of 16,485 tons in producers' inventories of refined lead, indicating conclusively that consumption of lead was less than producers' shipments.

Consumers' stocks of refined soft lead at beginning and end of 1941, by grades, in short tons [1]

	Domestic			Foreign (all grades)	Total
	Corroding	Chemical	Common		
Dec. 31, 1940	24,880	12,436	36,977	4,177	78,470
Dec. 31, 1941	36,351	17,209	36,251	14,524	104,335

[1] Based upon survey of approximately 475 companies.

DOMESTIC CONSUMPTION

New supply.—A complete picture of the increased supply of refined primary lead available for consumption in 1941 cannot be published, owing to the confidential nature of foreign trade information since September 1941. In the following table the apparent trend of supply is shown for the 4 years, 1937–40, but no attempt has been made to total the incomplete 1941 statistics. In 1941, imports that affect the total supply and exports that largely determine withdrawals are listed only for January to September, inclusive. The figures do not consider variation in producers' stocks, and as these have changed considerably during the past 5 years the quantities stated do not show the true trend in actual consumption of new lead.

Refined primary pig lead available for consumption in the United States, 1937–41, in short tons

	1937	1938	1939	1940	1941
Supply:					
Imports	2, 238	1, 905	5, 388	149, 889	[1] 179, 086
Production	467, 317	383, 669	484, 035	533, 179	570, 967
	469, 555	385, 574	489, 423	683, 068	([2])
Withdrawn: Exports	20, 091	[3] 45, 866	74, 392	[4] 49, 079	[1] 13, 494
Supply available for consumption	449, 464	339, 708	415, 031	633, 989	([2])

[1] Figures cover January to September, inclusive
[2] Figures not available for publication
[3] Includes small quantity of "sheets and pipes"; figures not separable.
[4] Includes 25,324 tons of foreign refined lead re-exported, according to American Bureau of Metal Statistics; official figures not available.

Consumption.—Consumption of lead in the United States during 1941 broke all records. The metal not only served as a war material in military applications and other defense uses but was called upon to help relieve the shortage of other metals, including aluminum, copper, zinc, and tin. Owing to the return of large quantities of secondary lead in discarded and obsolete articles and from the lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead available. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries, 1937–41.

Lead consumed in the United States, 1937–41, in short tons [1]

Purpose	1937	1938	1939	1940	1941
White lead	86, 000	71, 000	75, 000	65, 500	85, 000
Red lead and litharge	57, 000	43, 000	57, 200	59, 400	89, 100
Storage batteries	192, 000	167, 000	198, 000	220, 200	245, 000
Cable covering	90, 000	60, 000	74, 400	107, 400	173, 000
Building	45, 000	36, 000	50, 000	65, 000	95, 000
Automobiles	12, 000	6, 000	8, 900	11, 000	12, 000
Ammunition	39, 500	31, 200	42, 300	56, 000	71, 500
Terneplate	6, 400	4, 300	6, 000	6, 000	8, 700
Foil	21, 700	22, 000	21, 800	23, 500	45, 000
Bearing metal	15, 000	9, 000	12, 800	14, 000	25, 000
Solder	22, 000	15, 000	20, 000	24, 000	36, 000
Type metal	17, 000	12, 000	14, 000	16, 800	20, 000
Calking	15, 000	12, 000	16, 000	19, 200	31, 000
Castings	6, 000	6, 000	7, 500	9, 000	14, 000
Other uses	54, 100	51, 500	63, 100	85, 000	99, 700
	678, 700	546, 000	667, 000	782, 000	1, 050, 000

[1] American Bureau of Metal Statistics. These estimates are for total consumption of lead, irrespective of whether its origin is primary or secondary. Antimonial lead is included.

The quantity of lead consumed by industry in 1941, as estimated by the American Bureau of Metal Statistics, was 34 percent above that in 1940 and 8 percent greater than the previous high level established in 1929. The principal use of lead is in the manufacture of storage batteries, and in recent years requirements of lead for this purpose have averaged approximately 30 percent of the total. Although the lead thus used in 1941 reached a new record high, the amount was only 23 percent of the total lead consumed, as all uses increased over 1940. This high figure reflects the efforts of the automobile industry to produce a record number of vehicles before conversion of plant facilities to war production plus expanded production

of batteries for strictly military and naval use. Under normal conditions, lead withdrawn for use in storage batteries noticeably curtails the need for newly mined metal, as it rapidly returns to the trade in the form of scrap and there competes with the primary market. The use of lead for cable covering ranked again second but increased 61 percent. Although the white-lead industry dropped to fifth place, following increased consumption of lead for building and for red lead and litharge, the amount of lead used was 30 percent more than in 1940.

The increases in use of white lead, and also red lead (which advanced 50 percent), were due principally to the shortage of other pigments derived from aluminum, zinc, and titanium. Compared with the former record year 1929, lead consumption for the six major uses in 1941 was as follows: Use in storage batteries was greater by 17 percent, red lead and litharge 197 percent, and ammunition 74 percent; cable covering was 79 percent of the 1929 figure, white lead 71 percent, and building 99 percent. Of all the uses listed, six were higher in 1941 than in 1929 as compared with four in 1940.

In January 1942 the Bureau of Mines started a consumer survey of the use of refined soft lead during 1941. The results of this survey of approximately 475 companies are shown in the following table. Judging from available data as regards supply, shipments, and producers' stocks, the receipts of 838,835 tons of refined soft lead by those consumers canvassed indicate that the coverage was substantially complete. However, the total does not represent the entire consumption, as antimonial lead, unrefined scrap lead, and lead in alloys are not included. As this survey is the first attempt to show the actual picture of the consumer side of the industry, no comparative analysis can be made with 1940 or earlier years.

Consumption of refined soft lead in the United States in 1941, by grades and uses, in short tons [1]

By grades:		By uses—Continued.	
Domestic:		Collapsible tubes	3,726
Corroding	289,970	Foil	51,516
Chemical	150,237	Pipes, traps, and bends	32,946
Common	257,114	Sheet lead	35,480
Foreign: All grades	115,649	Solder	56,622
		Storage batteries	53,082
Total consumed	812,970	Terneplate	3,069
		Type metals	2,975
By uses:		White lead	83,230
Ammunition	33,011	Red lead and litharge	143,496
Bearing metals	10,318	Chemicals and insecticides	8,861
Cable covering	137,659	Other uses [2]	112,840
Calking lead	35,876		
Casting metals	9,263	Total consumed	812,970

[1] Based upon survey of approximately 475 companies; subject to revision.
[2] Includes consumption of lead in manufacture of tetraethyl lead used in tempering gasoline.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in this country is sold at prices based upon quotations in these markets. As the New York quotations are influenced to some extent by the lower prices that, in normal times, usually prevail on the London market, the New York price seldom exceeds the St. Louis price by as much as the freight difference (usually 0.35 cent a pound).

In 1941 the average prices for lead did not fluctuate, as in 1940, but followed the trend of the other common nonferrous metals and rose during the first quarter to a point of stabilization that was maintained for the rest of the year. The price for pig lead at New York, outside market, at the beginning of 1941 was 5.50 cents a pound. During subsequent weeks of heavy purchases the price advanced to 5.65 cents on February 10. Consumption continued to increase—at least in part attributable to additions to consumer inventory—and the quotation again jumped, rising to 5.75 cents on March 3. The increased use of lead as a substitute material for scarcer commodities added to the ever-growing demand, and the price advanced once more. This last step-up raised the quotation to 5.85 cents on March 26. What appeared to be forward buying on the part of consumers resulted in a continuation of demand above actual requirements. On April 5 the Office of Price Administration declared the possibility of a price ceiling and requested leading producers to refrain from further increases in price. This unofficial request was followed, and the price remained at 5.85 cents for the remainder of 1941. The average price for 1941 was 5.79 cents compared with 5.18 cents in 1940 and 5.05 cents in 1939.

Information regarding London Metal Exchange dealings, which were suspended at the outbreak of the war, continued to be unavailable during 1941.

In September 1939 the British Ministry of Supply announced the establishment of the maximum price of Empire lead at £17 per long ton ex ship and of foreign lead at £16 12s. 6d. ex ship. In December 1939 the Nonferrous Metal Control for the United Kingdom raised the price of Empire and foreign lead to £25 per long ton, duty paid, delivered. There was no reported change from this figure during 1941.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1939–41, in cents per pound [1]

Month	1939			1940			1941		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	4.68	4.83	3.03	5.32	5.47		5.35	5.50	
February	4.65	4.80	3.20	4.93	5.08		5.45	5.60	
March	4.67	4.82	3.07	5.04	5.19		5.61	5.77	
April	4.63	4.78	3.00	4.92	5.07		5.70	5.85	
May	4.60	4.75	3.03	4.87	5.02		5.70	5.85	
June	4.65	4.80	3.04	4.85	5.00	(2)	5.70	5.85	(2)
July	4.70	4.85	3.08	4.85	5.00		5.70	5.85	
August	4.89	5.04	3.30	4.70	4.85		5.70	5.85	
September	5.30	5.45	(2)	4.78	4.93		5.70	5.85	
October	5.35	5.50	(2)	5.16	5.31		5.70	5.85	
November	5.35	5.50	(2)	5.58	5.73		5.70	5.85	
December	5.35	5.50	(2)	5.35	5.50		5.70	5.85	
Average	4.90	5.05	[3][4] 3.09	5.03	5.18	(2)	5.64	5.79	(2)

[1] St. Louis: Metal Statistics, 1942, p. 473. Average daily quotations of soft Missouri lead, f. o. b. St. Louis (open market), as reported daily in American Metal Market.
New York: American Metal Market, daily issues. Pig lead, New York (outside market), prompt shipment from West.
London: Metal Statistics, 1942, p. 478. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by Federal Reserve Board.

[2] London Metal Exchange dealings suspended for duration of war. Official maximum price fixed by British Ministry of Supply at £25 in December 1939.

[3] London quotation in pounds sterling per long ton for first 8 months of 1939 was £14.7083.

[4] Average for 8 months; comparable average for New York was 4.83 cents.

FOREIGN TRADE [2]

As foreign trade statistics for 1941 can be given for only the 9-month period from January to September, no direct comparison can be made with 1940 totals. The figures do show that total lead imported during the period more than maintained the high level reached in 1940.

Imports.—Lead imported in the 9-month period totaled 260,892 short tons. Of this amount, pigs, bars, and old comprised 69 percent, lead in ore and matte 22 percent, and lead in base bullion 9 percent; the comparative ratio for 1940 was 54, 39, and 7 percent, respectively. Imports of pigs, bars, and old during 1941 continued to gain, and the 9-month total was substantially above the high level of 1940. Mexico, for years the principal source of imports of unrefined lead, contributed 38 percent of the total tonnage during the 9 months, followed by Canada with 21 percent. In 1940 the ratio was 53 and 3 percent, respectively, which indicates a remarkable gain from the latter country that was almost entirely in the form of pigs, bars, and old. This same category included notable tonnages from Australia and Peru. Mexico remained the principal source.

Total lead imported into the United States, 1937–41, by forms in which imported, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, and old	Total lead content
1937	34, 103	1, 800	4, 903	40, 806
1938	45, 370	15, 296	3, 235	63, 901
1939	30, 842	48, 902	7, 139	86, 883
1940	111, 300	19, 624	151, 568	282, 492
1941 (Jan.-Sept.)	58, 082	23, 631	179, 179	260, 892

[1] Data include lead imported for immediate consumption plus material entering country under bond.

Total lead imported into the United States, in ore, base bullion, and refined, 1937–41, by countries, in short tons [1]

Year	Canada	Mexico	New-found-land	South America [2]	Europe	Other countries	Total
1937	5, 749	17, 068		13, 229	535	4, 225	40, 806
1938	3, 174	38, 467		13, 426	680	8, 154	63, 901
1939	5, 641	52, 059	1	16, 527	1, 971	10, 684	86, 883
1940	8, 721	149, 493	27, 563	63, 120	3, 891	29, 704	282, 492
1941 (Jan.-Sept.)	54, 309	99, 226	15, 963	49, 846	176	41, 372	260, 892

[1] Data include lead imported for immediate consumption plus material entering country under bond.
[2] Includes imports from Argentina as follows—1937: 17 tons; 1938: 4 tons; 1939: 3,362 tons; 1940: 16,469 tons; and 1941 (Jan.-Sept.): 10,209 tons.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and old, 1937–41, by countries, in short tons [1]

Country	1937	1938	1939	1940	1941 (Jan.-Sept.)
In ore and matte:					
Africa			7	7,586	204
Argentina	17	4	3,362	16,469	10,209
Australia	2,241	6,434	7,612	17,472	14,616
Canada	5,211	3,173	5,624	8,666	3,879
Chile	474	2,107	1,844	6,271	1,300
Mexico	15,970	24,023	3,846	1,804	4,537
Newfoundland				27,563	15,963
Peru	10,132	9,317	7,174	18,383	3,415
United Kingdom	11	2	1,058	3,498	175
Other countries	47	310	315	3,588	3,784
	34,103	45,370	30,842	111,300	58,082
In base bullion:					
Mexico	1,067	14,444	47,915	19,009	23,494
Peru	239	198	84	179	52
Other countries	494	654	903	436	85
	1,800	15,296	48,902	19,624	23,631
In pigs, bars, and old:					
Australia	1,769	1,475	2,727	4,266	26,277
Canada	538	1	17	55	50,356
Mexico	31		298	128,680	71,195
Peru	2,344	1,736	4,051	18,452	31,324
Other countries	221	23	46	115	27
	4,903	3,235	7,139	151,568	179,179
	40,806	63,901	86,883	282,492	260,892

[1] Data include lead imported for immediate consumption plus material entering the country under bond

Lead remaining in warehouse in the United States, December 31, 1937–40, and September 30, 1941, in short tons

[Stated in the form in which material was entered for warehouse]

Year	Lead in ore and matte	Lead in base bullion [1]	Year	Lead in ore and matte	Lead in base bullion [1]
1937	57,509	2,622	1940	110,580	101,296
1938	76,287	11,524	1941 (Sept. 30)	105,944	47,343
1939	72,737	6,478			

[1] Figures also include pigs, bars, sheets, and old lead.

Lead [1] *imported for consumption in the United States, 1937–41, by forms in which imported*

Year	Lead in ores, flue dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1937	5,318	$507,945	188	$12,788	2,355	$174,077	376	$54,649	$13,527	$793,796
1938	6,722	543,164	304	31,147	2,001	84,109	166	30,906	23,381	733,081
1939	12,317	1,063,512	1,764	166,298	4,772	176,437	170	28,296	11,611	1,449,541
1940	70,027	4,659,445	9,992	929,946	36,882	2,269,075	201	36,444	12,046	7,910,873
1941 [2]	61,409	3,989,125	14,817	1,466,781	224,871	15,874,826	38	12,025	18,480	21,362,284

[1] In addition to quantities shown (values included in total values), "Reclaimed, scrap, etc." imported as follows—1937: 349 tons, valued at $30,810; 1938: 189 tons, $20,374; 1939: 36 tons, $3,387; 1940: 24 tons, $3,917; and 1941 (Jan.-Sept.): 9 tons, $1,047.

[2] January to September, inclusive.

Miscellaneous products, containing lead, imported for consumption in the United States, 1937–41

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1937	618	178	$213,734	132	115	$13,572
1938	390	77	126,660	433	374	38,708
1939	136	45	96,492	380	321	38,491
1940	1,368	429	1,026,432	1,482	1,291	108,286
1941 (Jan.-Sept.)	523	217	562,857	1,222	1,082	80,377

Exports.—In the 9-month period of 1941 exports were much smaller than the total for 1940, which indicates that the downtrend from the high level of 1939 is continuing. Exports by countries of destination are given only for the first quarter of 1941; they show the general distribution.

Lead exported from the United States, 1937–41

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1937	20,091	$1,838,262	8,679	1940	23,755	$1,794,590	15,604
1938	[1] 45,866	[1] 3,354,616	9,061	1941 [2]	13,494	1,057,368	14,310
1939	74,392	4,547,219	10,379				

[1] Includes sheets and pipes; figures not separable.
[2] January to September, inclusive.

Pig lead exported from the United States, 1937–41, by destinations, in short tons

Destination	1937	1938 [1]	1939	1940 [2]	1941 (Jan.-Mar.)
Countries:					
Belgium	43	28	588	644	
Brazil	652	111	647	1,559	73
Canada	7	101	5	34	1
Denmark			1,569		
Finland		560	616	112	
France		(3)	540	1,120	
Germany	568	1,092	8,333		
Hungary			560	487	
Japan	7,320	30,203	34,790	11,958	4,216
Kwangtung	56	314	99	336	
Mexico	8,122	11,403	2,922	15	5
Netherlands			2,101	2,352	
Norway	112		1,091		
Philippine Islands	569	1,037	974	450	5
Sweden		23	7,340	301	112
United Kingdom	2,226	78	9,411	2	
Other countries	416	916	2,806	4,435	963
	20,091	45,866	74,392	23,755	5,375
Continents:					
North America	8,337	12,002	3,345	865	108
South America	784	308	1,317	3,078	772
Europe	2,949	1,950	33,152	6,400	183
Asia	7,989	31,606	36,122	13,384	4,279
Africa and Oceania	32	5	456	28	33

[1] Includes sheets and pipes; figures not separable.
[2] In addition, 25,324 tons of foreign lead were re-exported, according to American Bureau of Metal Statistics; official figures not available.
[3] Less than 1 ton.

WORLD ASPECTS OF LEAD INDUSTRY

A statistical picture of the lead situation throughout the world in 1941 is more difficult to draw than in 1940, owing to an even greater scarcity of production data.

Although official data are lacking, it is doubtful if world production and consumption gained much in 1941; indeed, the reverse may have been true.

Some ot the details by countries, insofar as data are available under existing conditions of wartime restrictions, are discussed in the following pages.

REVIEW BY COUNTRIES

Argentina.—The Compania Minera Aguilar S. A., subsidiary of the St. Joseph Lead Co., supplied nearly 98 percent of the Argentine output of lead in 1941. During the year, Argentina produced 32,317 metric tons of 74-percent lead concentrates; in 1940 the output of concentrates amounted to 40,097 tons. From January to September (inclusive) 1941, 4,615 metric tons of lead ore were imported, almost entirely from Bolivia, compared with 2,888 tons for the same period in 1940. Nearly all the primary lead produced in Argentina comes from the National Lead Co. smelter at Puerto Vilelas; although the 1941 total is not known, production probably exceeded the 1940 figure of 12,864 metric tons, which included 2,476 tons from foreign ore.

Australia.—Although figures relating to production in Australia are not available for 1941, increased nonferrous metal-mining activity would appear to indicate an advance in lead output. Mt. Isa Mines, Ltd., continued to produce lead bullion steadily throughout 1941. The average mill extraction for the year ended June 30 was 79.7 percent lead recovered. During the year mining and milling continued at the property of the Lake George Mining Corporation, New South Wales, but toward the end of 1941 the lessened labor supply resulted in reduced output in the mine. With increased scarcity of shipping plus other factors, lead concentrates equal to nearly 8 months production had accumulated by the end of the year.

In Tasmania the North Farrell mine at Tullah is now the only producer of silver-lead ore. Output from the mine is reported to be 80 to 100 tons of concentrates a month.

Bolivia.—Mine production of lead in Bolivia, derived principally from small mines in the La Quiaca region, amounted to 15,654 metric tons contained in 26,356 tons of ore and concentrates. Production of lead in 1940 was 11,662 tons (content in ore). All concentrates are exported, during past years almost entirely to Argentina. The Bolivian Government has given the United States the exclusive right to purchase lead output, but during 1941 exports were divided between the United States and Argentina. It is reported that the Bolivian Banco Minero allotted 504,000 bolivianos for the erection of a lead smelter.

Brazil.—Production of lead remains comparatively undeveloped in Brazil. The Furnas lead-silver mine in the Iporanga district, State of São Paulo, is the principal producer and has considerable reserves of ore. The new selective-flotation plant of 35-ton daily capacity at Palmital treats ore averaging about 7 percent lead, 17 percent zinc, and 7 ounces of silver per ton and produces a 55.6-

percent lead concentrate containing 50 ounces of silver per ton. Recovery is approximately 79 percent. Operating in conjunction with this plant is a new lead-silver smelter completed in July 1941—the first to be built in Brazil. Potential daily capacity, following pilot-plant operations, is 10 metric tons of refined lead and 25 kilograms of silver; the lead produced will be placed on the domestic market, and the silver will go to the mint. Power for the operations is obtained from a hydroelectric plant at Salto do Colabouco on the Palmital River near Apiai. Although a larger output from the district is expected, the mines do not produce enough at present to keep the smelter operating at full capacity.

Canada.—Although data on production of lead in Canada continued to be unavailable, it is understood that the Canadian metal industry more than maintained the high production rate attained in 1940. The Sullivan mine of the Consolidated Mining & Smelting Co., in British Columbia, reputedly produced 90 percent of the total Canadian lead output. Large quantities have been shipped to the United States through contract with the Metals Reserve Co., and reserve stocks are reportedly near exhaustion. Mining has been resumed at numerous smaller properties, including that of the Lake Geneva Mining Co., Ltd., northwest of Sudbury and at the old Calumet Island property near Ottawa.

Arrangements have reportedly been made by Reeves McDonald Mines, Ltd., to construct a zinc-lead smelter at its property in the West Kootenay district of British Columbia to be in operation late in 1942.

Mexico.—Mine production of lead in Mexico during 1941 amounted to 155,259 metric tons, a considerable decrease from the 196,250 tons produced in 1940. Exports of lead in all forms from January to September (inclusive) 1941 totaled 114,603 metric tons compared with 138,739 tons for the same period in 1940. Of this total, 90,116 tons (nearly 79 percent) were exported to the United States compared with 79 percent for the entire year 1940.

Mexico continued to have labor problems in 1941. The American Smelting & Refining Co. closed its Monterrey refinery in the State of Nuevo León, owing to a strike on April 28, and did not reopen it until June 16. The capacity of the refinery is 18,000 tons a month. There was also a strike at the Monterrey refinery of the American Metal Co., Ltd., from September 8 to October 20; it adversely affected Mexican output, and full production was not resumed for some time after its settlement.

Peru.—Mine production of lead in Peru in 1941 totaled 54,822 metric tons compared with 50,439 tons in 1940. Exports from Peru during 1941 included an estimated 8,000 tons of lead ore, 12,000 tons of concentrates, and 38,000 tons of pig lead, compared with 5,430, 19,086, and 23,241 tons, respectively, in 1940. Of the total lead shipped, the Cerro de Pasco Copper Corporation supplied about 85 percent. The corporation is installing a third lead furnace at the Oroya smelter—the only one in Peru—to keep the refinery operating at capacity. Output of refined lead will be increased to about 45,000 tons annually. Construction of the new 800-ton-per-day lead-zinc concentrator is progressing, but the plant is not scheduled for completion before late 1942 or in 1943.

Spain.—Little information has been available regarding the Spanish lead industry during and following the years of the Spanish Civil War, which was concluded in 1939. It is reported that mine production of lead in 1940 amounted to about 57,900 metric tons and that 42,400 tons of metal were produced. For 10 months of 1941, mine and metal production has been given as approximately 35,600 and 24,400 tons, respectively.

Sweden.—In an effort to alleviate the acute lead shortage, the Swedish Boliden Mining Co. is preparing to mine and concentrate lead ore. The concentrates will be shipped to the Rönnskär smelter at Skelleftead for treatment. The company has extensive holdings at Laisvall in northern Sweden.

ZINC[1]

By A. L. Ransome

SUMMARY OUTLINE

GENERAL SUMMARY

The zinc industry in 1941 again was characterized by its well-geared relationship with the national defense program. The spirit of cooperation between Government and the zinc industry resulted in a year of smooth-running but intense activity that broke all records in an endeavor to meet increased demands for the metal. The smelting industry increased its output 22 percent over 1940 to a new all-time record and at the same time managed to show a gain of 26 percent in stocks above the low point reached at the end of 1940. The augmented supply was inadequate, and consumers' stocks continued to decrease. Continued heavy demand for high-grade zinc resulted in a 29-percent gain in output above the exceptionally high total for 1940. In comparison, the lower grades of zinc advanced 16 percent. At the close of 1941, smelters were operating at usable capacity, which was 96 percent of the total available, with additional capacity under construction and planned in excess of new capacity added since 1940.

Although domestic mine output increased 13 percent to a point only 3 percent below the 1926 record, it could not meet the gain in consumption, and smelters continued to use foreign ore in even greater amounts than in 1940. Imports in the first 9 months of 1941 exceeded the previous record for 1940 (12 months) and sufficed to establish an all-time record for domestic output of zinc from foreign ores, as well as a marked increase in ore inventories at the smelters.

[1] This report deals primarily with the smelting branch of the industry. Full details of zinc mining are given in the various State reports. Some zinc ore is used directly in the manufacture of zinc pigments. See chapter on Lead and Zinc Pigments and Zinc Salts.)

Salient statistics of the zinc industry in the United States, 1925–29 (average), and 1937–41

	1925–29 (average)	1937	1938	1939	1940	1941
Production of primary slab zinc:						
By sources:						
From domestic ores .... short tons..	589,648	551,165	436,007	491,058	589,988	652,599
From foreign ores .... do....	12,734	5,739	10,334	16,178	85,287	169,421
	602,382	556,904	446,341	507,236	675,275	822,020
By methods						
Electrolytic .... percent of total..	21	21	21	25	28	27
Distilled .... do....	79	79	79	75	72	73
Production of redistilled secondary slab zinc .... short tons.	43,756	51,554	31,613	50,428	48,917	59,503
Stocks on hand at primary smelters Dec. 31 short tons..	45,575	79,144	157,511	83,728	19,212	24,212
Primary zinc available for consumption short tons..	548,472	570,219	375,004	607,464	677,168	(1)
Price:						
Prime Western at St. Louis						
Average for year .... cents per pound..	6.76	6 52	4 61	5.12	6.34	7.48
Highest quotation .... do....	8 90	7 50	5.05	6.50	7.25	8.25
Lowest quotation .... do....	5 40	5.00	4 00	4.50	5.50	7 25
Yearly average at London .... do...	6 46	4 91	3 05	[2] 2 89	(3)	(3)
Mine production of recoverable zinc short tons..	724,720	626,362	516,699	583,807	665,068	749,125
Tri State district (Joplin) percent of total..	49	38	38	38	35	35
Western States .... do....	30	31	28	29	36	38
Other .... do...	21	31	34	33	29	27
World smelter production of zinc short tons..	1,435,000	1,789,000	1,728,000	1,800,000	(3)	(3)

[1] Figures not available for publication.
[2] Average for 8 months, London Metal Exchange dealings suspended in September
[3] Data not available

Only one change was made in the price of slab zinc after September 24, 1940. On October 9, 1941, the Office of Price Administration raised the official quotation for Prime Western zinc at St. Louis from 7.25 to 8.25 cents a pound in an effort to expand output from marginal producers. This was the highest price level reached in 15 years. The average quoted price for 1941 was 7.48 cents compared with 6.34 cents in 1940 and 5.12 cents in 1939.

Figure 1 shows trends in the domestic zinc industry since 1900.

National defense activity.—The rising tide of defense preparations during 1941, plus the initiation of Lend-Lease activities, was climaxed in December by the unprovoked Japanese attack upon Pearl Harbor. Thus the year closed with an abrupt change from a national policy of defense against aggression to active participation in the world conflict, with accompanying necessary alterations in the peacetime industrial pattern.

During 1940 the shortage of zinc became more acute, and by the end of the year producers had voluntarily initiated a system of allocating supplies of zinc to consumers. Imposition of Government priorities in deliveries was suggested as early as November, but no positive action was taken until March 1941. On January 30, 1941, a Priorities Committee for Nonferrous Metals was established in the Priorities Division of the Office of Production Management. Exports of zinc ores, slab zinc, and manufactures of zinc were added to the list of materials subject to export control on February 3. On February 20 the American Zinc Institute appointed a committee to coordinate

zinc supplies between producers and consumers. The tight situation continued, and informal action was taken by the Priorities Division to facilitate the flow of zinc into military uses, nondefense consumers being urged to cooperate voluntarily.

On March 7 the Office of Production Management announced the creation of a zinc pool effective for April, when an amount of zinc equal to 5 percent of the January output would be requisitioned from the April production to alleviate shortages in defense industries. The pool requirements increased throughout the remainder of 1941 and

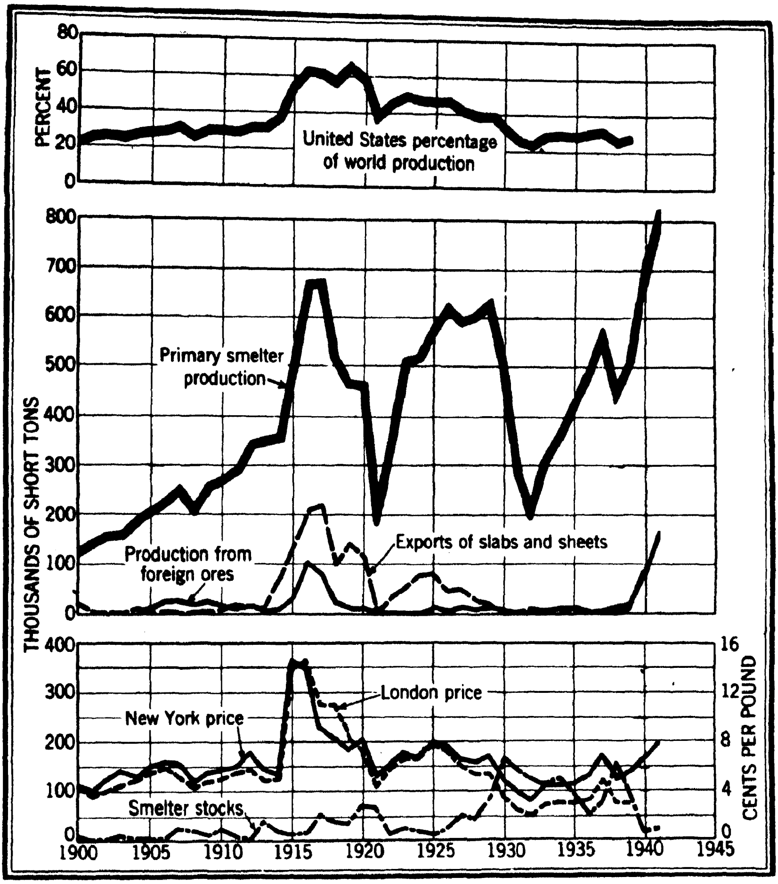

FIGURE 1.—Trends in the zinc industry in the United States, 1900–1941. Imports for consumption of slab and sheet zinc are not shown; before 1936 they seldom exceeded 500 tons annually, but in recent years they have increased, amounting to 37,439 tons in 1937, 7,456 tons in 1938, 31,138 tons in 1939, 10,164 tons in 1940, and 31,066 tons in 1941 (January–September, inclusive).

until May 1942, when amounts were set at 75 percent of high-grade and 50 percent of the lower grades based upon January production. The following table lists the zinc-pool percentage requirements by months, as ordered by the Office of Production Management during 1941 and by the War Production Board after creation of that agency on January 16, 1942, to absorb and take over the duties of the Office of Production Management.

Zinc-pool percentage requirements

From production in—		An amount equal to—
1941	April	5 percent of January 1941 total output.
	May	17 percent of March 1941 total output.
	June	22 percent of April 1941 total output.
	July	22 percent of May 1941 total output.
	August	27 percent of June 1941 total output.
	September	27 percent of July 1941 total output.
	October	27 percent of August 1941 total output.
	November	31 percent of August 1941 total output.
	December	29 percent of August 1941 total output.
1942	January	31 percent of October 1941 total output.
	February	40 percent of November 1941 total output.
	March	50 percent of December 1941 high-grade [1] output. 40 percent of December 1941 lower grade [2] output.
	April	60 percent of January 1942 high-grade [1] output. 40 percent of January 1942 lower grade [2] output.
	May	75 percent of January 1942 high-grade [1] output. 50 percent of January 1942 lower grade [2] output.

[1] Special High Grade and Regular High Grade
[2] Intermediate, Brass Special, Selected, and Prime Western

The Division of Industry Operations of the War Production Board announced on May 1 that zinc would be placed under full allocation on June 1. The same order stated that zinc produced from foreign ores in bond could be re-exported upon issuance of a license by the Office of Export Control of the Board of Economic Warfare.

Smelting capacity.—Under existing conditions of all-out production, zinc-smelting capacity is best measured by actual production data with estimated future production based upon added capacity of new facilities under construction and planned. Industry's estimate of 1941 production (announced in February 1941) from ores and secondary material (excluding production from graphite retorts) was 864,000 short tons. This figure came remarkably close to the actual comparable total of 863,263 tons as compiled by the Bureau of Mines. It has been estimated that total production of 881,523 tons of primary and secondary metal in the United States in 1941 will be increased to 956,000 tons[2] in 1942 by the use of additional capacity under construction, with the possibility of even further expansion for 1943. The results of the feverish activity in the zinc industry to adjust itself to war economy and enlarge production can best be judged by comparing present data with those for 1938, when the output was 478,000 tons.

Supply of zinc concentrates.—In 1941 the domestic mine production of zinc increased 13 percent over the 1940 total, owing in large part to the increase in price of zinc. Domestic supply of ore was supplemented by amounts of foreign concentrates large enough to produce the record 1941 output of metal plus necessary uses of ore in other industries, and still build up a considerable inventory of ore and concentrates by the end of 1941. The Office of Production Management, jointly with the Office of Price Administration, on January 13, 1942, announced the details of a premium-price plan, whereby producers of zinc (copper and lead are also included in the plan) would receive, through the Metals Reserve Co., 11 cents a pound for zinc produced in excess of quotas based upon 1941 output, effective as of February 1, 1942, for 2½ years. Although the result undoubtedly will be an increased domestic production, the percentage gain is

[2] Young, Howard I., Slab Zinc Review: Am. Zinc Inst. Ann. Convention, April 29, 1941; mim. by that agency.

conjectural. The expected increase in the rate of production has been estimated (according to the joint O. P. M.–O. P. A. announcement of January 13) at 30 percent by the end of 1942, as compared with the 1941 year-end rate. Even considering such a possible increase this country must still look to imports of foreign concentrates to continue at about the same rate as in 1941. This import rate must, if possible, be maintained by increasing imports from sources that involve rail movements rather than ships, in view of the hazards that today accompany ocean transport.

DOMESTIC PRODUCTION

Production of primary and redistilled secondary slab zinc.—The production of 822,020 short tons of primary slab zinc from domestic and foreign ores in 1941 was the highest ever recorded and exceeded the previous record of 1940 by 22 percent; the total was 23 percent higher than that for the peak year of 1917 and 37 percent more than the average annual output in the 5 years 1925–29. Both domestic and foreign ores contributed to the increase, as production from the former source advanced 11 percent and that from the latter 99 percent. The output from domestic ores was the largest on record, and the quantity produced from foreign ores was 63 percent greater than the previous high of 104,005 tons in 1916.

The production of redistilled secondary slab zinc increased 22 percent. To prevent inadvertent duplication, figures for the output of remelted secondary slab zinc are not included with those for redistilled metal. In 1941, 10,389 tons were recovered by remelting purchased scrap. Zinc rolling mills and other consumers recover considerably more than this from their own plant scrap, but such metal normally does not enter the market and is not measured statistically.

Primary and redistilled secondary slab zinc produced in the United States, 1937–41, in short tons

Year	Primary			Redistilled secondary	Total (excludes remelted)
	Domestic	Foreign [1]	Total		
1937	551,165	5,739	556,904	51,554	608,458
1938	436,007	10,334	446,341	31,613	477,954
1939	491,058	16,178	507,236	50,428	557,664
1940	589,988	85,287	675,275	48,917	724,192
1941	652,599	169,421	822,020	59,503	881,523

[1] Most of the foreign ores smelted in the United States in 1937-38 originated in Peru; in 1939, in Mexico, Peru, and Argentina; and in 1940-41, principally in Mexico, Canada, Newfoundland, and Peru

Distilled and electrolytic zinc.—Of the primary zinc produced in 1941, 73 percent was distilled and 27 percent electrolytic compared with 72 and 28 percent, respectively, in 1940.

Because of the significant part of zinc in the manufacture of items both for military and civilian uses, producers were requested to report their output of each grade in 1941. In 1940 Special High Grade was separately reported for the first time, and the 1941 statistics show a continued exceptional demand for this grade that was exceeded only by Prime Western. All grades that were directly comparable with

1940 figures showed increases. Special High Grade gained 4 percent, Regular High Grade 79 percent, Intermediate 15 percent, and Prime Western 22 percent. The combined total of Brass Special and Selected was slightly less than the comparable figure for 1940; these two grades, not segregated in preceding years, amounted to only 8 and less than 1 percent, respectively, of the total zinc production in 1941.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1937–41, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1937	117,511	439,393	24,131	27,423	608,458
1938	93,272	353,069	14,003	17,610	477,954
1939	127,056	380,180	23,471	26,957	557,664
1940	187,040	488,235	20,003	28,914	724,192
1941	224,313	597,707	27,904	31,599	881,523

APPORTIONED ACCORDING TO GRADE

Year	Grade A		Grade B (Intermediate)	Grades C and D		Grade E (Prime Western)	Total
	Special High Grade (99.99%Zn)	Ordinary		Brass Special	Selected		
1937	196,052		67,132	72,993		272,281	608,458
1938	140,256		58,128	73,724		205,846	477,954
1939	162,345		66,591	86,274		242,454	557,664
1940	195,119	98,940	65,321	80,681		284,131	724,192
1941	203,030	177,451	74,797	73,968	5,152	347,125	881,523

[1] For total production of secondary zinc see chapter on Secondary Metals—Nonferrous.

Production of primary slab zinc by States.—Pennsylvania continued to be the leading producer of primary slab zinc in the United States, a distinction held without interruption since 1934. Montana and Illinois ranked next in order of importance, closely followed by Oklahoma. The positions of Arkansas and Idaho were reversed from 1940, and Arkansas again took the lead over Idaho. All producing States continued to show gains; the increases were particularly marked in Pennsylvania, Illinois, and the West Virginia-Texas group, where they were 27, 20, and 42 percent, respectively. Montana and Idaho, as usual, produced electrolytic zinc only. Whereas all other States produced distilled zinc only in 1940, Illinois produced electrolytic zinc as well as distilled metal in 1941.

Primary slab zinc produced in the United States, by States, where smelted, 1937–41, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Other States [1]	Total	
								Short tons	Value
1937	25,799	22,831	73,151	94,680	96,153	175,275	69,015	556,904	$72,398,000
1938	20,476	15,634	68,167	77,638	68,224	139,897	56,305	446,341	42,849,000
1939	19,892	18,427	79,480	108,629	84,551	155,598	40,659	507,236	52,753,000
1940	35,497	37,477	101,819	149,563	96,689	175,352	78,878	675,275	85,085,000
1941	44,045	39,285	121,921	176,406	105,885	222,486	111,992	822,020	123,303,000

[1] Texas and West Virginia.

Secondary zinc.—In addition to the redistilled secondary slab zinc (unalloyed) already reported herein, some remelted slab is produced, and a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Additional information on secondary zinc is given in the chapter on Secondary Metals—Nonferrous.

Byproduct sulfuric acid.—Sulfuric acid made from the sulfur dioxide gases produced in roasting zinc blende (sphalerite) is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consume large quantities of sulfur. The production of sulfuric acid at zinc blende roasting plants from 1937 to 1941 is shown in the following table.

Sulfuric acid (60° B. basis) made at zinc blende roasting plants in the United States, 1937–1941

Year	Made from zinc blende [1]		Made from sulfur		Total [1]		
	Short tons	Value [2]	Short tons	Value [2]	Short tons	Value [2] Total	Value [2] Average per ton
1937	542, 356	$5, 060, 181	151, 090	$1, 409, 670	693, 446	$6, 469, 851	$9. 33
1938	466, 879	4, 253, 268	30, 996	282, 373	497, 875	4, 535, 641	9. 11
1939	528, 872	4, 765, 137	102, 663	924, 993	631, 535	5, 690, 130	9. 01
1940	586, 912	5, 364, 376	134, 250	1, 227, 045	721, 162	6, 591, 421	9. 14
1941	672, 177	5, 706, 783	148, 257	1, 258, 702	820, 434	6, 965, 485	8. 49

[1] Includes acid from foreign blende. [2] At average of sales of 60° acid.

Rolled zinc.—Production of rolled zinc increased 21 percent in 1941, and the average value advanced 14 percent (from $0.100 in 1940 to $0.114 in 1941). Some mills that fabricate their rolled zinc into various finished products remelt and reroll the resulting scrap. The scrap thus treated in 1941 amounted to 14,586 tons, a 43-percent gain over 1940. The zinc lost in such waste products as skimmings, dross, and pot losses totaled 1,838 tons in 1941, an amount equivalent to about 2.6 percent of the net production of rolled zinc (the same ratio as in 1940). Zinc purchased for rolling in 1941 comprised 34 percent High Grade, 29 percent Brass Special, 19 percent Intermediate, 14 percent Selected, and 4 percent Prime Western. These figures compare with the 1940 figures of 16, 41, 22, 5, and 16 percent, respectively. The increased use of the higher grades of zinc continues the trend in this direction noted in 1940 and probably reflects the gain in production of the higher grades of zinc during 1941 plus their increased use in rolled products in the expanded national defense program. Stocks of slab zinc on hand at rolling mills were about 5,200 tons (revised figure) at the beginning and 3,336 tons at the end of the year.

Rolled zinc produced and quantity available for consumption in the United States, 1940–41

	1940			1941		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	[1] 16,547	[1] $3,876,000	$0.117	18,823	$4,933,000	$0.131
Boiler plate and sheets over 0.1 inch thick	1,904	363,000	.095	3,610	775,000	.107
Strip and ribbon zinc [2]	[1] 38,948	[1] 7,220,000	[1] .093	47,046	10,125,000	.108
Total rolled zinc [2]	57,399	[1] 11,459,000	[1] .100	69,479	15,833,000	.114
Imports	18	2,800		[3] 71	[3] 14,000	
Exports	7,055	1,421,100	.101	[3] 3,067	[3] 724,500	.118
Available for consumption	50,362			(4)		
Value of slab zinc (all grades)			.063			.075
Value added by rolling			.037			.039

[1] Revised figures.
[2] Figures represent net production. In addition, 10,183 tons of strip and ribbon zinc in 1940 and 14,586 tons in 1941 were rerolled from scrap originating in fabricating plants operated in connection with zinc rolling mills.
[3] Figures cover January to September, inclusive.
[4] Figure not available for publication.

Zinc dust.—Production of zinc dust in 1941 advanced to the highest level in the history of the industry and was 18 percent above the previous record established in 1940. The zinc content of dust ranged from 94.0 to 99.0 percent and averaged 97.7 percent.

The largest present use for zinc dust is in the manufacture of chemicals consumed in the process of printing and dyeing textiles. These chemicals, for the most part, act as reducing and bleaching agents. Other uses of zinc dust in approximate order of importance are: The metallurgical uses, including precipitation of gold, silver, and other heavy metals and production of cadmium; the sherardizing of iron; and the production of zinc paints. Some miscellaneous uses include chemicals (other than those mentioned above), manufacture of ceramics, refining of lubricants, production of oil-well drilling compounds, pipe-joint compounds, soot removers, and smoke screens, and in the Schori process of metal spraying. The last-named use is increasing in this country, and the chemical use in smoke screens undoubtedly will gain sharply because of the war.

Zinc dust is manufactured principally from galvanizers' dross, and in 1941 more than three-quarters of the total produced came from this one source. The rest of the production was from ore, metallic zinc, die-cast scrap, and numerous miscellaneous scrap zinc items, and as a byproduct of zinc refining.

Zinc dust[1] *produced in the United States, 1937–41*

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1937	15,242	$2,587,577	$0.085	1940	20,731	$3,404,970	$0.082
1938	11,609	1,542,511	.066	1941	24,429	4,641,580	.095
1939	16,835	2,367,861	070				

[1] All produced by distillation.

Zinc pigments and salts.—The principal zinc pigments are zinc oxide and lithopone, and the principal salts are the chloride and sulfate. These products are manufactured from various zinciferous materials, including ore, metal, and secondary substances. Details of the production of zinc pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Mine production.—Mine production of zinc showed a general increase in the Western, Central, and Eastern States, with an over-all gain of approximately 13 percent during 1941; the advance amounted to 40,532 tons or 17 percent in the Western States, 31,030 tons or 13 percent in the Central States, and 12,495 tons or 7 percent in the Eastern States. Oklahoma continued to be the principal producer in the country by a wide margin, contributing more than half of the yield from the Central States which supplied 37 percent of the total mine production in 1941. The increased output in this area, as well as for the entire country, can be attributed directly to the ever-increasing demand, coupled with the continued higher level of prices. As in 1940, the Tri-State (or Joplin) region supplied 35 percent and Southeastern Missouri and the other Central States only 2 percent of total domestic production. Output from Arkansas and Kentucky declined during 1941.

All the Western States, except Utah, gained in production during 1941; they yielded 38 percent of the total domestic output. Idaho continued to be the largest producer in this region, with a 12-percent increase over the previous record level of 1940. Montana again ranked second, with the largest output since 1929, and Utah maintained third place (despite a drop in production) but was closely followed by New Mexico. Output of zinc from Arizona was the largest in the history of the State and resulted from increased activity at mines producing zinc-lead ore. About 95 percent of the production from Nevada came from the Pioche district. The output from Washington gained 24 percent and was the highest ever recorded for the State; nearly all of it came from three properties at Metaline Falls.

Among the Eastern States, New Jersey continued to be the leading producer and maintained its rank as second in importance in the country, with an output higher than in any year since 1937. Output from the newly developed Hyatt mine in St. Lawrence County, N. Y., contributed to the 8-percent increase in 1941 for that State. Production in Tennessee was higher than in any previous year. Although shipments of concentrates from Virginia were greater than in 1940, actual mine production was less.

Mine production of recoverable zinc in the United States, 1925–29 (average) and 1937–41, by States, in short tons

State	1925–29 (average)	1937	1938	1939	1940	1941
Western States.						
Arizona	2,628	5,026	5,814	6,711	15,456	16,493
California	3,999	20	--	6	79	440
Colorado	32,868	4,247	4,553	1,830	5,060	15,722
Idaho	29,128	54,199	44,030	47,549	70,601	79,084
Montana	72,519	39,168	8,844	34,799	52,587	60,710
Nevada	5,570	14,236	8,944	6,228	11,833	15,129
New Mexico	23,351	23,927	28,236	29,356	30,313	37,862
Oregon	---	24	---	---	---	---
Utah	44,385	48,001	33,658	34,526	43,788	42,049
Washington	575	4,116	11,402	10,131	11,560	14,320
	215,023	192,964	145,481	171,136	241,277	281,809
Central States						
Arkansas	71	241	152	123	440	206
Illinois	1,174	----	----	334	4,818	9,198
Kansas	114,323	80,300	73,024	68,971	57,032	71,403
Kentucky	644	270	322	909	1,278	427
Missouri	16,708	20,600	10,226	15,096	12,703	21,932
Oklahoma	226,969	135,696	112,924	140,379	162,935	166,602
Wisconsin	23,055	6,938	2,073	5,904	5,770	6,238
	382,944	244,045	198,721	231,716	244,976	276,006
Eastern States						
New Jersey	93,839	101,408	85,839	88,716	91,406	93,781
New York	7,091	32,690	29,896	36,014	35,686	38,446
Tennessee	} 25,823	55,255	56,766	56,225	{ 34,796	36,170
Virginia					16,927	22,913
	126,753	189,353	172,501	180,955	178,815	191,310
	724,720	626,362	516,703	583,807	665,068	749,125

Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1937–41, in short tons

District	State	1937	1938	1939	1940	1941
Joplin region	Kansas, Southwestern Missouri, Oklahoma	236,585	196,174	224,446	232,437	258,837
New Jersey	New Jersey	101,408	85,839	88,716	91,406	93,781
Coeur d'Alene region	Idaho	47,070	31,937	40,065	62,948	68,321
St. Lawrence County	New York	32,690	29,896	36,014	35,686	38,446
Summit Valley (Butte)	Montana	22,033	942	20,016	35,899	28,070
Eastern Tennessee	Tennessee	[1] 55,255	[1] 56,766	[1] 56,225	34,796	36,170
Central	New Mexico	11,887	16,695	23,677	29,573	34,649
Austinville	Virginia	(1)	(1)	(1)	[2] 16,927	[2] 22,913
Bingham	Utah	20,570	23,096	20,861	21,812	20,496
Smelter	Montana	10,330	6,063	12,639	14,462	18,751
Park City region	Utah	19,342	5,678	9,054	17,598	16,177
Pioche	Nevada	12,472	8,414	5,737	10,773	14,391
Metaline	Washington	4,095	11,402	10,130	11,560	14,201
Red Cliff	Colorado					10,880
Warm Springs	Idaho	6,959	12,070	7,463	7,104	8,534
Upper Mississippi Valley	Iowa, Northern Illinois, Wisconsin	6,938	2,073	5,904	5,776	7,95[illegible]
Kentucky-Southern Illinois	Kentucky-Southern Illinois	270	322	1,243	6,090	7,907
Pioneer	Arizona		825	2,000	3,175	4,139
San Juan Mountains	Colorado	2,092	4,308	1,465	4,151	3,894
Rush Valley	Utah	2,205	1,955	2,370	2,971	3,726
Harshaw	Arizona	--		1,075	2,714	3,531
Magdalena	New Mexico	755	218	317	206	2,580
Wallapai	Arizona	1,714	1,660	770	4,295	2,346
Warren	do		--	7	1,812	2,095
Big Bug	do	-	-	110	1,740	1,804
Montana	Montana		---	5	713	1,474
Eagle	do	632	550	394	418	1,048
Tintic	Utah	1,259	921	851	225	797
Ophir	do	4,023	1,893	1,268	603	173
Cataract	Montana	1,043	605	1,070	773	93
Leadville	Colorado	1,676	97	172	172	48
Flint Creek	Montana	4,641	426	663	99	41
Oro Blanco	Arizona	2,700	3,265	2,377	484	-
Willow Creek	New Mexico	10,882	11,291	4,925		-
Tybo	Nevada	1,417	- -	--	-	-

[1] Virginia included with Tennessee for 1937–39. Bureau of Mines not at liberty to publish separately.
[2] Includes a very small quantity produced elsewhere in the State.

STOCKS

Producers' stocks.—Stocks of zinc at primary reduction plants, although still at a low level, gained 26 percent by the end of 1941; the comparatively small inventories held at secondary distilling plants increased 17 percent; and total stocks also rose 26 percent. Of the total stocks on hand at the end of the year, 18,491 tons were of the higher grades of zinc (A and B) and 6,611 tons of the lower grades (C, D, and E) compared with 9,710 and 10,263 tons, respectively, at the end of 1940.

According to the American Zinc Institute, stocks of slab zinc followed a general downward trend during the first half of 1941 and reached the low point for the year at the end of June. Comparable figures for the same date in past years are not available, but the midyear stock figure was lower than any year-end total since 1913. During the latter half of 1941, stock totals advanced steadily, so that the year-end figure was somewhat higher than that at the beginning of 1941.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1937–41, in short tons

	1937	1938	1939	1940	1941
At primary reduction plants	79, 144	157, 511	83, 728	19, 212	24, 212
At secondary distilling plants	1, 969	1, 915	2, 555	761	890
	81, 113	159, 426	86, 283	19, 973	25, 102

Stocks of zinc ore (60-percent concentrates) in the Tri-State district (as reported by the Tri-State Zinc and Lead Ore Producers' Association) on December 28, 1940, totaled about 2,800 short tons with a drop to 1,200 tons on January 4, 1941, as shipments continued to increase over production. Production began to gain and by February 22 exceeded shipments, with a resultant advance in stocks to 6,500 tons. This was followed by a sharp initial drop and a subsequent gradual falling off of stocks to 4,900 tons by the end of the first quarter (March 29).

During the second quarter of 1941, stocks first rose to 6,100 tons on April 19 and then showed a general slight downward trend to 5,000 tons on June 28. In this same period, production for the most part exceeded shipments; but by July 5 shipments greatly exceeded production, and stocks dropped to 3,500 tons. Following this midyear low, stocks climbed steadily (with but one notable decrease—in the latter part of August) to 9,300 tons on October 11—the peak for 1941. A subsequent sharp gain in shipments, with continued excess over slightly rising production, caused a rapid depletion of stocks to 2,900 tons on November 29, followed by a gain to 3,800 tons on December 27; however, a marked rise in shipments, accompanied by a slight decrease in production, resulted in stocks dropping to 1,500 tons on January 3, 1942—the lowest point reached since January 4, 1941.

Data on stocks of metallic zinc outside the United States continue to be unavailable, owing to the disruption of international trade in zinc ore caused by the war.

Consumers' stocks.—The monthly survey of consumer stocks, first made by the Bureau of Mines in September 1940, was continued throughout 1941. In the following table the totals, by months, from

December 1940 through June 1941 are based upon a canvass of approximately 300 companies with an estimated industrial coverage of about 90 percent at the first of the year. In August the survey was expanded to include more than 500 respondents, representing over 95 percent of the consuming industry; stock totals were recorded upon this basis beginning July 31.

Consumers' stocks of slab zinc at plants at month's end, December 1940 to December 1941, by industries, in short tons [1]

	Galvanizers	Die casters	Brass mills	Zinc rolling mills	Oxide plants	Others	Total
1940:							
December	31,612	12,937	16,410	6,067		638	67,664
1941:							
January	29,621	11,619	10,948	5,010		727	57,925
February	27,039	10,422	11,515	5,159		801	54,936
March	26,556	7,548	8,016	5.567		820	48,507
April	24,611	5,993	10,712	3,637		856	45,809
May	21,798	5,449	11,999	3,697		899	43,842
June	22,481	5,594	14,485	3 577		846	46,983
July	27,703	6,410	18,448	2,862	443	1,832	57,698
August	26,809	6,206	15,748	3,533	268	2,113	54,677
September	28,718	7,300	16,231	3,689	152	1,860	57,950
October	29,803	7,538	14,831	3,637	240	1,744	57,793
November	29,049	8,026	17,890	3,808	301	1,676	60,750
December	31,508	9,320	19,049	3,569	164	1,672	65,282

[1] Based upon canvass of approximately 300 companies from January through June, expanded to 520 companies beginning July 31.

In addition to the zinc recorded in the foregoing data on physical inventories at plants, several thousand tons were in transit and held for redistillation at the end of each month. The total of this additional metal ranged from as low as 10,530 tons to as high as 15,924 tons for month-ends from December 31, 1940, to December 31, 1941, with an average of about 13,200 tons a month for the year.

Although the monthly stock data do give a general picture, the results for July through December are not directly comparable with preceding months, because of variance in coverage and certain changes in industrial classification. These differences are indicated by the following table, which gives the final stock totals for the beginning and end of 1941, based upon an annual consumer survey for the calendar year 1941. Total inventories decreased 11 percent.

Consumers' stocks of slab zinc at plants at the beginning and end of 1941, by industries, in short tons [1]

	Galvanizers	Die casters	Brass mills	Zinc rolling mills	Oxide plants	Others	Total
December 31, 1940	34,903	13,522	20,412	5,251	767	1 760	76,615
December 31, 1941	33,506	9,846	19,069	3,371	319	1,977	68,088

[1] Based upon canvass of approximately 600 companies.

DOMESTIC CONSUMPTION

New supply.—A complete picture of the supply of new zinc available for consumption in 1941 cannot be published, owing to the confidential nature of foreign trade information since September 1941. In the following table the trend of supply is shown for the 4 years,

1937–40, but no attempt has been made to total the incomplete 1941 statistics. In 1941 imports that affect the total supply and exports that largely determine withdrawals are listed only for January to September, inclusive.

In addition to primary zinc, redistilled secondary metal was available for consumption in 1941. Allowing for a slight increase in stocks at secondary smelters, the supply of this material available to consumers totaled 59,374 tons.

Primary slab zinc available for consumption in the United States, 1937–41, in short tons

	1937	1938	1939	1940	1941
Supply:					
Stock at smelters Jan 1	55,500	79,144	157,511	83,728	19,212
Production	556,904	446,341	507,236	675,275	822,020
Imports for consumption	37,208	7,230	30,960	[1] 16,468	[1] [2] 25,212
Total available	649,612	532,715	695,707	775,471	([3])
Withdrawn:					
Exports	249	[4] 200	4,515	79,091	[2] 57,909
Stock at smelters Dec 31	79,144	157,511	83,728	19,212	24,212
Total withdrawn	79,393	157,711	88,243	98,303	([3])
Available for consumption	570,219	375,004	607,464	677,168	([3])

[1] General imports.
[2] Figures cover January to September, inclusive
[3] Figures not available for publication.
[4] Not separately recorded, estimated.

Consumption.—The survey by the Bureau of Mines of zinc consumers for the calendar year 1941, mentioned earlier in this chapter under the heading Consumers' Stocks, showed that a record total of 827,435 tons of zinc actually was consumed in 1941 by approximately 600 companies, representing virtually 100 percent of the consuming industry. In comparison, a similar survey for 1940 gave a consumption total of about 733,000 tons. Receipts of zinc by consumers in 1941 totaled 818,908 tons, and the rest was supplied by an 8,527-ton withdrawal from consumers' inventories. A break-down of the total consumed, by industrial groups and principal uses in each group, was obtained for 1941 for the first time. These figures are given in the following tabulation, but no comparison can be made with previous years.

Consumption of slab zinc in the United States in 1941, by industries, in short tons[1]

Galvanizing:[2]		Die-casting alloy	150,853
Sheets	129,028	Rolled and ribbon zinc	72,049
Tubes and pipe	69,749	Zinc oxide	16,128
Wire	41,408		
Wire cloth	11,307	Other uses	
Shapes[3]	99,362	Slush castings	751
		Wet batteries	1,767
	350,854	Desilvering lead	1,431
		Miscellaneous[4]	5,564
Brass products:			
Sheets, tubes, etc	195,714		9,513
Ingots	9,497		
Castings	4,509	Total consumption: All uses	827,435
Miscellaneous	18,318		
	228,038		

[1] Based upon canvass of approximately 600 companies.
[2] Includes zinc used in electrogalvanizing but excludes sherardizing
[3] Includes pole-line hardware, hollow ware, chains, and miscellaneous articles not elsewhere mentioned
[4] Includes slab zinc used in manufacture of zinc dust.

The estimated industrial use of primary and secondary zinc, as calculated by the American Bureau of Metal Statistics, cannot be directly compared with the Bureau of Mines consumption figures for 1941 because the results were attained by separate methods and certain data are subject to different interpretation. Nevertheless, the figures in the following table are particularly valuable as they show the indicated trend over a period of several years.

Estimated industrial use of zinc in the United States, 1937–41, in short tons [1]

Purpose	1937	1938	1939	1940	1941
Galvanizing:					
Sheets	139,000	108,500	147,500	147,700	138,500
Tubes	37,000	29,300	43,300	51,200	55,000
Wire	33,000	23,600	33,000	33,900	37,100
Wire cloth	7,000	5,600	7,700	8,400	8,600
Shapes [2]	40,000	31,000	43,500	45,800	60,800
	256,000	198,000	275,000	287,000	300,000
Brass making	169,000	102,000	175,000	232,000	313,000
Rolled zinc	58,000	46,000	62,000	58,000	69,000
Die castings	88,000	48,000	84,000	116,000	125,000
Other uses [3]	39,000	27,000	30,000	26,000	24,000
	610,000	421,000	626,000	719,000	831,000

[1] American Bureau of Metal Statistics, Year Book, 1941.
[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned
[3] Includes slab zinc used for manufacture of French oxide, zinc for wet batteries, slush castings, the desilverization of lead, wire for metalizing, etc., and sundries.

The quantity of zinc used by industry in 1941, as estimated by the American Bureau of Metal Statistics, was 16 percent higher than the previous record established in 1940. According to the data in the foregoing table, all the principal uses indicate increases in 1941—galvanizing 5 percent, brass making 35 percent, and die castings 8 percent. Galvanizing took 36 percent of the total tonnage in 1941 compared with 40 percent in 1940 and 44 percent in 1939. This item includes zinc used in electrogalvanizing and that used in sherardizing; the former increased from 6,071 tons in 1940 to 7,594 tons in 1941, and the latter from 618 to 944 tons. An incomplete break-down of the zinc used in rolled products in 1941 (1940 figures in parentheses) included 20,975 tons (20,985) in battery cans, 3,600 (1,904) in boiler plate, and 449 (426) in brake lining. The remaining tonnage was distributed for glass jar tops, photoengraving sheet, and automobile manufacture and for miscellaneous uses or export. The chief item in "Other uses" is the slab zinc employed in making French-process zinc oxide.

PRICES

Despite the ever-increasing demand for zinc, from January through September the price of Prime Western at St. Louis continued at the 7.25-cent-a-pound rate established September 24, 1940. In an effort to expand output from marginal producers, the Office of Price Administration raised the base price on October 9, 1941, from 7.25 to 8.25 cents, where it remained for the rest of 1941 The price of zinc

concentrates quickly followed with a rise of \$6.70 to \$55.28 per ton for 60-percent zinc concentrates in the Tri-State market, the highest reached in 15 years. The average quoted price for zinc in 1941 was 7.48 cents compared with 6.34 cents in 1940.

Information on London Metal Exchange dealings, which were suspended at the outbreak of the war, continued to be unavailable during 1941. On December 18, 1939, the Nonferrous Metal Control for the United Kingdom fixed the price of zinc at £25 15s., delivered consumers, duty paid, for foreign zinc, and £26 10s., for domestic metal. These established prices did not change during 1941.

Price of zinc and zinc concentrates, 1937–41

	1937	1938	1939	1940	1941
Average price of common zinc at—					
St. Louis (spot) .... cents per pound..	6.52	4.61	5.12	6.34	7.48
New York .... do....	6.87	4.99	5.51	6.73	7.87
London .... do....	4.91	3.05	[1] 2.89	[2]	[2]
Excess New York over London .... do....	1.96	1.94	[3] 2.03	[4]	[4]
Joplin 60-percent zinc concentrates:					
Price per short ton .... dollars..	39.87	27.83	34.15	41.87	49.80
Price of zinc content .... cents per pound..	3.32	2.32	2.85	3.49	4.15
Smelter margin .... do....	3.20	2.29	2.27	2.85	3.33
Price indexes (1925–29 average = 100):					
Zinc (New York)	97	70	77	95	111
Lead (New York)	80	63	68	69	78
Copper (New York)	90	70	75	77	80
Nonferrous metals [5]	91	74	79	82	85
All commodities [5]	88	80	79	80	89

[1] Average for 8 months; London Metal Exchange dealings suspended in September.
[2] Official maximum price fixed by British Ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1940–41 rate of exchange.
[3] Difference based upon 8-month averages.
[4] Not available
[5] Based upon price indexes of U. S. Department of Labor.

Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1940–41[1]

Month	1940: 60-percent zinc concentrates in the Joplin region (dollars per ton)	1940: Metallic zinc (cents per pound) St. Louis	1940: Metallic zinc (cents per pound) London	1941: 60-percent zinc concentrates in the Joplin region (dollars per ton)	1941: Metallic zinc (cents per pound) St. Louis	1941: Metallic zinc (cents per pound) London
January	\$38.15	5.64	[2]	\$48.20	7.25	[2]
February	35.43	5.54		48.22	7.25	
March	37.05	5.75		48.19	7.25	
April	37.50	5.75		48.20	7.25	
May	37.70	5.81		48.20	7.25	
June	40.54	6.24		48.21	7.25	
July	41.37	6.25		48.21	7.25	
August	41.98	6.40		48.22	7.25	
September	44.75	6.94		46.39	7.25	
October	48.24	7.25		52.88	7.99	
November	48.23	7.25		55.28	8.25	
December	48.19	7.25		55.28	8.25	
Average for year	41.87	6.34	[2]	49.80	7.48	[2]

[1] All quotations from Metal Statistics, 1942.
[2] Official maximum price fixed by British Ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1940–41 rate of exchange.

Average price received by producers for zinc, 1937–41, by grades, in cents per pound

	1937	1938	1939	1940	1941
Grade A: [1]					
Special High Grade					8.04
Regular High Grade	6.65	5.03	5.34	6.59	7.74
Grade B: Intermediate					7.52
Grades C and D: [1]					
Brass Special	6.47	4.73	5.00	6.04	7.37
Selected					6.64
Grade E: Prime Western	6.44	4.71	5.08	6.14	7.16
All grades	6.5	4.8	5.2	6.3	7.5
Prime Western; spot quotation at St. Louis	6.5	4.6	5.1	6.3	7.5

[1] American Metal Market quotes average prices of High Grade and Brass Special as follows: High Grade (f. o. b. New York)—1937, 7.76 cents; 1938, 5.74 cents; 1939, 6.16 cents; 1940, 7.38 cents; 1941, 8.48 cents. Brass Special (f. o. b. East St. Louis)—1937, 6 62 cents; 1938, 4.71 cents; 1939, 5.22 cents; 1940, 6.44 cents; 1941, 7.68 cents.

ZINC-REDUCTION PLANTS

Zinc smelters.—No changes took place during 1941 in the number of active and idle zinc smelters; as in 1940, there were 17 active plants and 1 idle plant. Of those active, 13 continued to operate with horizontal retorts exclusively, 1 with both horizontal and vertical retorts, 2 with large vertical retorts exclusively, and 1 with electrothermic furnaces. The total number of retorts reported at the active horizontal-retort primary plants was 68,552, a 10-percent increase over the 62,368 recorded for December 31, 1940. Of the total retorts reported, 65,969 were in use, a 19-percent increase over the 55,328 in operation at the close of 1940. Although this active equipment represented 96 percent of the total at the regular plants, smelting operations were at usable capacity throughout 1941; the remainder represents a rapidly decreasing amount of equipment that has been idle for some time and is being replaced or reconditioned, plus a certain percentage that was closed down for necessary repairs. At the end of 1941, 800 new retorts were under construction. The 14 new large vertical retorts under construction at the end of 1940 were completed during 1941, bringing the total reported to 66, of which 64 were in use at the year's end.

Many primary smelters treat scrap as well as ore. Horizontal-retort plants at Beckemeyer and Sandoval, Ill., and graphite-retort plants at Trenton, N. J., Philadelphia and Bristol, Pa., Wheeling, W. Va., Tottenville, N. Y., and Fairfield, Ala., handle scrap exclusively. Graphite retorts were also operated during 1941 by Morris P. Kirk & Son, Inc., Los Angeles, Calif., and the New England Chemical Works, Putnam, Conn.; both concerns use scrap exclusively. The Torrance (Calif.) plant of the Pacific Smelting Co., Ltd. uses small clay retorts as well as graphite retorts for treating secondary materials. Although no units were reported under construction at secondary plants during 1941, additional graphite retorts are planned for future installation at Fairfield and Philadelphia.

Electrolytic plants.—Four electrolytic plants were in operation during 1941 compared with three in 1940. The plant of the American Zinc Co. of Illinois at East St. Louis, Ill., which opened in May 1941, operated at full capacity thereafter during the year, and construction work was planned for doubling the output. The plant of the Sullivan Mining Co. at Kellogg, Idaho, made full use of its capacity. The Anaconda Copper Mining Co. plant at Anaconda, Mont., operated to

full extent, and the Great Falls plant ran at near capacity; both plants increased their capacity over 1940, and additional plant facilities were planned for 1942. At the four plants, 2,502 cells out of a total of 2,526 were in use at the end of 1941 compared with 2,204 out of 2,228 at three plants at the end of 1940; no new cells were reported under construction at the end of the year, but 348 additional cells were planned for 1942. The American Smelting & Refining Co. electrolytic zinc plant at Corpus Christi, Tex., which was begun in 1940, was still under construction at the end of 1941 but should be ready to operate in 1942 with an annual capacity of 25,000 tons of zinc.

FOREIGN TRADE [3]

Imports.—The following tables give zinc total imports (general) in ore and blocks, pigs, or slabs into the United States, 1939–40, and from January through September 1941; imports for consumption, 1937–40 and 9 months of 1941; and a record of bonded warehouse inventories, 1937–41.

Zinc imported into the United States in ore, blocks, pigs, or slabs, 1939–41, by countries, in short tons [1]

Country	1939	1940	1941 (Jan.-Sept.)
Ore (zinc content):			
Argentina	1, 544	6, 723	5, 320
Australia		1, 749	8, 933
Belgian Congo			8, 161
Bolivia		2, 530	2, 687
Canada	1, 613	33, 993	33, 991
Chile		611	
Mexico	23, 221	93, 789	92, 544
Newfoundland and Labrador		23, 640	3, 531
Peru	9, 722	17, 285	21, 822
Spain			5, 119
	36, 100	180, 320	182, 108
Blocks, pigs, or slabs:			
Belgium	4, 678	336	
Canada	6, 402	6, 938	6, 704
Indochina, French			1, 102
Mexico	16, 556	8, 948	17, 362
Other countries	3, 262	246	44
	30, 898	16, 468	25, 212

[1] Data include ore imported for immediate consumption plus material entering country under bond.

Zinc [1] *remaining in warehouse in the United States, December 31, 1937–40, and September 30, 1941*

	Pounds
1937	24, 904, 405
1938	51, 058, 373
1939	20, 295, 817
1940	184, 442, 754
1941 (Sept. 30)	279, 092, 943

[1] Includes zinc ore (zinc content) and zinc blocks, pigs, old, and sheets.

As imports in 1941 are listed for only 9 months no direct comparisons can be made with 1940 totals, but statistics for the January–September period do give an interesting picture of the trend since 1940. By September 30, imports of zinc ore and concentrates were

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

greater than the 1940 total. Mexico remained the chief source, with shipments amounting to 51 percent of the total, followed by Canada and Peru; although figures for all three countries indicate that totals for the year exceeded those for 1940, Peru shows the greatest gain. Increased amounts came from Australia and Bolivia; but imports from Newfoundland and Labrador in the 9 months declined appreciably, and none were reported from Chile. A substantial tonnage was obtained from Argentina, as well as from Belgian Congo and Spain. The rapid rise in the amount of zinc remaining in warehouse (from 184,442,754 pounds at the end of 1940 to 279,092,943 pounds on September 30, 1941) is due largely to the preponderance of total imports (general) over imports for consumption.

Before 1940, total (general) imports of slab zinc very closely approximated imports for consumption, whereas in 1940 total imports were higher than imports for consumption by about 6,000 tons. Upon the basis of 9-months' totals the reverse is indicated for 1941; the 30,995 tons imported for consumption during this period (12-months' figures for 1940 in parentheses) included 23,085 tons (2,647) from Mexico, 6,704 tons (6,877) from Canada, and the rest from French Indochina, Australia, and Peru. In comparison, the 9-months' total (general) imports of slab zinc—25,212 tons—included 17,362 tons (8,948) from Mexico and 6,704 tons (6,938) from Canada.

Zinc imported for consumption in the United States, 1937–41, by classes

Year	Ores (zinc content)		Blocks, pigs, or slabs		Sheets		Old, dross, and skimmings [1]		Zinc dust		Total value [2]
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1937	3,345	$177,457	37,208	$3,852,884	231	$30,398	678	$70,460	69	$6,169	$4,137,368
1938	4,860	392,591	7,230	480,169	226	25,989	96	8,944	64	5,074	912,767
1939	33,503	1,304,433	30,960	1,890,236	178	21,166	203	14,067	41	3,388	3,233,290
1940	44,637	1,108,361	10,146	801,331	18	2,796	520	36,689			1,949,177
1941 [3]	66,976	2,421,632	30,995	2,841,071	71	14,029	412	28,065	68	12,301	5,317,098

[1] Includes dross and skimmings as follows—1937. 560 tons, valued at $59,635, 1938. None reported, 1939 30 tons, $1,918, 1940· 356 tons, $21,815, and 1941 (Jan -Sept.) 353 tons, $23,028

[2] In addition, manufactures of zinc imported as follows—1937. $828, 1938 $463, 1939 $1,545; 1940 $32, 1941 (Jan -Sept.)· $68.

[3] January to September, inclusive

Exports.—The value of exports in 1941 (January–September) of zinc ore and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) amounted to $9,557,706 compared with $11,302,228 in the full year 1940. The maintenance of this high over-all value was due to increased prices. Slabs, plates, or blocks continued to be the largest export group. In addition to the items shown in the accompanying tables, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. The American Bureau of Metal Statistics estimates that 14,300 tons of zinc were exported in galvanized products from January through September 1941. Export data on zinc pigments and chemicals are given in this volume in the chapter on Lead and Zinc Pigments and Zinc Salts. Much of the zinc used in the manufacture of such products is of foreign origin, and when they are exported a draw-back of 99 percent of the import duty is paid on the

basis of zinc contained in the finished product. For the 9-month period in 1941, draw-back was paid on 22,777 tons of zinc, of which 7,638 tons had been imported as slabs and 15,139 tons as ore. Totals for preceding years were: 1940, 19,306 tons; 1939, 16,213 tons; 1938, 11,550 tons; 1937, 9,253 tons; and 1936, 8,909 tons.

In the following table on exports of slab and sheet zinc by countries of destination, the figures only for the first quarter of 1941 are given to show the general distribution. The influence of the Lend-Lease program in 1941 is indicated by the large tonnage exported to the United Kingdom during the 3-month period.

Slab and sheet zinc exported from the United States, 1938–40, and January to March, 1941, by destinations, in short tons

Destination	Slabs, plates, and blocks				Sheets, strips, or other forms, n. e. s.			
	1938 [1]	1939	1940	1941 (Jan.–Mar.)	1938 [1]	1939	1940	1941 (Jan.–Mar.)
Country:								
Argentina	(1)	56	890	349	471	404	579	195
Australia	(1)				841	1,052	246	
Brazil	(1)	526	1,391	471	9	50	96	58
Canada	(1)	5	(2)	(2)	2,317	2,902	2,813	491
Chile	(1)	298	428		9	20	130	41
China	(1)	201	4,115	21	11	148	40	91
India, British	(1)		9,634	1,288	110	122	1,422	313
Japan	(1)	3,252	13,958	175	232	5	259	
United Kingdom	(1)		36,718	9,559	775	841	585	2
Other countries	(1)	177	11,957	576	961	1,164	1,320	611
Total	(1)	4,515	79,091	12,439	5,736	6,708	7,490	1,802
Continent.								
North America	(1)	31	258	18	2,527	3,167	3,127	581
South America	(1)	996	2,760	822	643	555	997	359
Europe	(1)		45,982	9,559	914	952	783	111
Asia	(1)	3,488	29,431	1,950	673	741	1,657	642
Africa	(1)		640		107	159	653	109
Oceania	(1)		20	90	872	1,134	273	

[1] Slabs, blocks, or pigs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Less than 1 ton.

Zinc ore and manufactures of zinc exported from the United States, 1937–41

Year	Zinc ore, concentrates, and dross (zinc content)		Slabs, plates, or blocks		Sheets, strips or other forms, n. e. s.		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	314	$10,145	249	$25,706	5,813	$1,103,533	2,145	$418,376
1938	135	6,404	(1)	(1)	[1] 5,736	[1] 908,381	2,253	355,856
1939	303	11,253	4,515	479,338	[2] 6,708	[2] 1,116,485	2,834	468,516
1940	448	42,207	79,091	9,103,030	[2] 7,490	[2] 1,564,720	3,044	592,271
1941 (Jan.–Sept.)			57,909	8,252,009	[2] 3,539	[2] 859,837	1,954	445,860

[1] Pigs and slabs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Includes "Other forms, n. e. s. (including scrap)", as follows—1939: 259 tons, valued $64,434; 1940: 435 tons, $143,652; and 1941 (Jan.–Sept.): 472 tons, $135,297. Not separately classified before 1939.

WORLD ASPECTS OF ZINC INDUSTRY

A perspective of the zinc situation throughout the world in 1941 shows continuation of the abnormal conditions that prevailed during 1940.

Although official data are lacking, the serious need for zinc for military and civilian use indicates that world production and consumption of this metal were greater in 1941 than ever before. Some of the details by countries, where such information is available, are discussed in the following pages. Owing to the serious lack of data for 1940 and 1941, the table showing world smelter production has been omitted.

REVIEW BY COUNTRIES

Argentina.—Production of zinc concentrates in Argentina in 1941 amounted to 66,010 metric tons containing about 36,300 tons of zinc, only slightly below the 1940 total of 66,384 tons containing approximately 37,000 tons of zinc.. The Aguilar mine of the St. Joseph Lead Co. in the Province of Jujoy is still virtually the only producer. This and other smaller mines supply concentrates for the Puerto Vilelas smelter. During 1940 a large percentage of the output of concentrates accumulated as stocks as the result of difficulty in disposing of them. In June 1941 the United States, through the Metals Reserve Co., purchased the greater part of such stocks on hand. Reportedly this purchase amounted to 100,000 long tons of concentrates containing 42,500 long tons of recoverable zinc.

Australia.—Base-metal production statistics for Australia for 1941 are not available. A prominent feature in development work at the various zinc properties is the use of diamond drilling. Late in 1941 diamond drilling at New Broken Hill gave evidence of a reversal of pitch of the present ore body, which, if true, means that the main body to the south will be shallower. This would have an important bearing on future mining practice. Operations at Broken Hill during 1941 continued in the usual efficient manner; at North Broken Hill the main feature of the mining operations has been the continued success attending extraction of ore from lode pillars, as 23.8 percent of the ore mined in the North section during the last operating period was won from this source. Ore reserves were estimated at 5,232,000 long tons as of June 30, 1941. Broken Hill South, Ltd., introduced a hydraulic system of stope filling Lower-grade crude ore treated at this property during 1941 was offset by improved metallurgy resulting in the following recoveries: Lead, 96.1 percent; silver, 92.2 percent; and zinc, 89.1 percent. The latest available figures for the Zinc Corporation, Ltd., indicate ore reserves of about 3,650,000 long tons.

The Broken Hill Associated Smelters at Port Pirie are reported to be conducting research as to the feasibility of recovering zinc from accumulated blast-furnace slag containing 15.78 percent zinc and a minor amount of lead. Mt. Isa Mines, Ltd., Queensland, continued to make a steady output of zinc concentrates during 1941. Estimated sulfide ore reserves, as of June 30, 1941, have been reported to total 8,775,300 tons averaging 8.65 percent zinc.

Bolivia.—Mine production of zinc (content in ore) in Bolivia amounted to only 6,065 metric tons in 1941 compared with 12,197 tons in 1940. Bolivian output of zinc ore and concentrates is comparatively small, and no apparent reserve stocks are carried.

Brazil.—The zinc-bearing zone of the Iporanga district, São Paulo, is the most important in Brazil. Reserves of sphalerite and calamine ore, containing 31 to 36 percent zinc and estimated as amounting to 30,000 metric tons, have been reported near the Apiai lead-silver

deposits. Other deposits occur in Minas Gerais at Januaria and at Morro do Bule near Curo Preto. The only zinc currently being produced in Brazil is in the form of a byproduct from the Furnas lead-silver mine in the Iporanga district. The ore averages 7 percent lead and 17 percent zinc. The new selective-flotation mill has a daily capacity of 35 tons and produces 55-percent zinc concentrates with a recovery of 83 percent.

Burma.—Ore reserves of the Bawdwin mines, at the end of the fiscal year (June 30, 1941), were estimated at 3,130,200 tons of ore assaying 15.1 ounces of silver, 19.5 percent lead, and 12.1 percent zinc, or slightly lower both in tonnage and metal content than estimates for the previous fiscal period.

Canada.—Continued war restrictions prevent the publication of base-metal production figures for Canada. The drive for zinc output by the Consolidated Mining & Smelting Co. has resulted in a greater production of lead as well. By the end of 1941, Waite Amulet was treating about 1,500 tons of ore a day. The new 300-ton addition to the mill, in operation since October 1941, has been producing zinc for the American market. It is reported that the Hudson Bay Mining & Smelting Co. has recently installed a 10-ton pilot plant for the experimental treatment of zinc residues that have accumulated at Flin Flon since 1930. Successful operation may result in the expansion of facilities for commercial-scale treatment of about 250,000 tons of this material. By the end of 1941, mining operations had been resumed at the old Calumet Island property near Ottawa; ore reserves have been estimated at 1,300,000 tons.

Canadian zinc-ore exports continued to go largely to the United States and in the 9-month period from January through September 1941 amounted to 34,000 tons compared with the same amount in all of 1940. The United Kingdom was the chief market for slab-zinc exports, although the amount shipped to the United States during the January-September period was nearly equal to the total for 1940. The ban on exports of zinc dross, remelted zinc in slabs, or high-grade zinc scrap remained in effect throughout 1941. Measures have been taken by the Canadian Government to conserve for essential purposes all available supplies of zinc that are in demand for defense purposes. As a result of this program of curtailment, 75 percent of the estimated use of zinc in 1941 was for essential purposes and 25 percent nonessential. In comparison, the division in 1940 was 36 and 64 percent, respectively.

Mexico.—Mine production of zinc in Mexico totaled 154,996 metric tons in 1941, compared with 114,955 tons in 1940. This large increase reflects the great demand for zinc in the United States, to which approximately 84,000 metric tons (content in ore and concentrates) were exported from January through September 1941. A considerable part of this tonnage came from stock piles accumulated after the sea blockade had cut off European markets in 1939. Smelter output totaled 31,500 metric tons, a drop from the 33,400 tons produced in 1940, due largely to labor difficulties at the beginning of the year at the Rosita smelter of the American Smelting & Refining Co.

Peru.—Production of zinc concentrates in Peru during 1941 totaled approximately 40,800 metric tons, with an extractable zinc content of 23,700 tons, a marked increase over the 1940 total of 29,467 tons

containing 17,000 tons of zinc. This output is principally from the properties of the Cerro de Pasco Copper Corporation. Construction of the new 800-ton-per-day lead-zinc concentrator is progressing, but the plant is not scheduled for completion before late 1942 or in 1943. The corporation's 5-ton pilot electrolytic zinc plant operated successfully in 1940 and 1941, and erection of a commercial-size refinery of 100 tons daily capacity is under consideration.

Spain.—Little information has been available regarding the Spanish zinc industry during and following the years of the Spanish Civil War, which was concluded in 1939. It is reported that mine production of zinc in 1940 amounted to about 74,000 metric tons and that 12,300 tons of metal were produced. For 10 months of 1941, mine and metal production has been given as 60,900 and 10,400 tons, respectively. The zinc deposits of Spain are mainly in the Santander region, the principal mines being operated by the Real Compañía Asturiana de Minas.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By H. M. Meyer and A. W. Mitchell

SUMMARY OUTLINE

GENERAL SUMMARY

Expansion in the use of lead and zinc pigments, forecast in the report of this series for 1940, resulted in the establishment of several new high records for this group of commodities in 1941. The achievements were due to considerable gains in the use of litharge and red lead for storage batteries and of dry white lead, leaded zinc oxide, and others for the manufacture of paint, to outstanding advances in the use of zinc oxide for rubber manufacture, to the use of unprecedented quantities of litharge and zinc oxide in ceramics, and to record amounts of litharge used in insecticides. In 1941 consumption of black oxide or suboxide of lead, not included in the pigments totals, also rose above all previous years.

The actual demand for many products in 1941, particularly those made from metals and metallic ores, is impossible to gage. Sales of zinc and lead pigments unquestionably would have been much larger had adequate quantities of raw materials for their unrestricted manufacture been available. Moreover, the relationship of zinc, lead, and titanium pigment totals in that year undoubtedly would have been more favorable to titanium and zinc, because raw materials for these pigments were more restricted than those for the lead group

Zinc is closely related to war needs, more so than lead. Consequently, a tight situation in zinc metal and scrap for the manufacture of pigments arose early in the war. This condition affected zinc oxide more than other pigments, for more metal is used in its manufacture than in any other zinc pigment. In recent years the use of scrap in making zinc oxide had risen so that roughly equal quantities of zinc oxide and lithopone (in terms of zinc content) were made from scrap materials. More than half of the zinc oxide manufactured, however, is made direct from ore. Although zinc oxide sales increased 31 percent during 1941, the zinc content of oxide made from metal and scrap actually decreased more than 5,000 tons; output from ores, meanwhile, increased 29,000 tons in terms of zinc content. As early

as June 10, 1941, zinc was placed under full priority control by the Office of Production Management (now the War Production Board). Producers of zinc oxide were ordered to set aside in July an amount equivalent to 10 percent of their May output for emergency allocation by the Director of Priorities. From then until the end of the year the amount to be set aside ranged from 10 percent for some months to none for others; the percentage usually applied to the second preceding month.

Pig lead supplies appeared to be satisfactory at the beginning of 1941; however, the greatly expanded use of this metal for war and civilian purposes, partly as a substitute for scarcer materials, brought noteworthy changes in this favorable position as the year progressed. Consequently, lead was placed under full priority control in October.

In 1941 lead pigments, as a group, made a better showing than zinc pigments in relation to 1940, as the total quantities sold advanced 37 and 27 percent, respectively. In relation of 1941 to averages for 1925–29, however, zinc pigments performed better, having risen 10 percent compared with 1 percent for lead pigments. Failure of white lead in oil to maintain its relative position caused the poorer showing of lead pigments in the latter comparison.

The titanium pigments group, competitors in the white pigment field, experienced unprecedented activity again in 1941.

Average quoted prices for lead and zinc pigments were generally higher in 1941 than in 1940, and the average values reported to have been received by producers confirmed the trend of quotations.

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1937–41

	1925–29 (average)	1937	1938	1939	1940	1941
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons..	154,483	98,213	100,213	98,429	80,562	113,000
Litharge............do....	84,845	83,902	68,711	89,518	89,841	122,280
Red lead............do....	41,362	33,931	30,183	39,976	42,200	53,838
Zinc oxide..........do....	154,208	114,652	70,129	114,552	113,213	148,833
Leaded zinc oxide...do....	26,609	40,348	38,216	42,684	45,362	68,920
Lithopone...........do....	177,745	154,771	125,746	142,759	151,802	176,642
Value of products:						
All lead pigments..........	$60,092,000	$35,676,000	$28,351,000	$35,485,000	$32,628,000	$46,572,000
All zinc pigments..........	41,314,000	28,038,000	23,301,000	28,794,000	28,747,000	39,210,000
Total..................	101,406,000	63,714,000	51,652,000	64,279,000	61,375,000	85,782,000
Value per ton received by producers:						
White lead (dry)..........	178	140	123	128	137	147
Litharge..................	176	143	122	123	126	134
Red lead..................	193	160	137	140	141	161
Zinc oxide................	133	103	117	117	118	125
Leaded zinc oxide.........	124	104	107	114	114	118
Lithopone.................	98	78	79	73	67	71
Foreign trade:						
Lead pigments:						
Value of exports......	1,346,000	586,000	510,000	715,000	594,000	[1] 833,000
Value of imports......	30,000	17,000	10,000	10,000	14,000	[1] 9,000
Zinc pigments:						
Value of exports......	2,150,000	610,000	339,000	925,000	1,585,000	[1] 2,313,000
Value of imports......	931,000	414,000	285,000	280,000	46,000	[1] 15,000
Export balance.....	2,535,000	765,000	554,000	1,350,000	2,119,000	[1] 3,122,000

[1] Figures cover January to September, inclusive.

PRODUCTION

Sales have more significance in this report than production, owing to lack of data on stocks at the beginning and end of the year. In some instances materials reported as one commodity for production have been sold later under another classification. Therefore, sales figures afford a more accurate guide to the pigments actually going into consumption. To prevent duplication, care is necessary even in handling sales figures. Some pigments reported as sales of finished products at one plant actually are used by other plants as an intermediate product in the manufacture of another pigment covered by the lead and zinc pigments canvass. Basic lead sulfate consumed in the manufacture of leaded zinc oxide is the principal problem in this connection, but it is not the only one. Production figures are employed in this report only in calculating the metal content of pigments and salts in the section on Raw Materials Used in Manufacture of Lead and Zinc Pigments and Zinc Salts. Pigments used by producers in manufacturing products at their own plants are included as sales.

The total value of sales of lead and zinc pigments showed a 40-percent rise, from $61,375,000 in 1940 to $85,782,000 in 1941. This noteworthy increase was due to advances in sales of all pigments and to gains in average values received by producers for virtually all items.

Lead pigments.—The lead pigments that in 1941 rose above all previous years in sales were litharge, red lead, and white lead (dry); these commodities gained 36, 25, and 26 percent, respectively, over previous high records established in 1940, 1929, and 1925. On the whole, price quotations in 1941 did not exceed the higher levels of the 1940 range; but, in general, they were above the lower levels, so that average quoted prices topped those of the earlier year. In 1941 most of the lead pigments made gains in average value received by producers. Consequently, although lead pigments showed a notable rise (37 percent) in total quantity the increase (43 percent) in their total value was even greater.

White lead in oil advanced 16 percent in 1941 but lagged behind all other pigments. Gains in sales of white lead (dry) brought this pigment up to 94-percent of the quantity of the paste product, the highest proportion it has ever attained in this relationship.

Lead pigments sold by domestic manufacturers in the United States, 1940–41

Pigment	1940			1941		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead:						
White	5,493	$692,769	$126	8,739	$1,122,622	$128
Blue	707	92,076	130	1,631	211,816	130
Red lead	42,200	5,970,156	141	53,838	8,687,469	161
Orange mineral	137	30,441	222	246	57,516	234
Litharge	89,841	11,305,954	126	122,280	16,416,507	134
White lead:						
Dry	30,115	4,114,785	137	54,689	8,013,421	147
In oil [1]	50,447	10,421,585	207	58,311	12,062,375	207

[1] Weight of white lead only but value of paste.

Lead pigments sold by domestic manufacturers in the United States, 1910–41, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1910	32,237	111,573	9,858		[1] 19,801	[1] 676	23,742
1911	25,834	106,778	10,019		[1] 19,540	[1] 766	25,190
1912	26,242	120,591	11,085		[1] 21,120	[1] 545	29,111
1913	24,196	118,430	12,452		[1] 17,635	[1] 434	23,093
1914	29,076	130,398	12,665		[1] 18,697	[1] 426	27,345
1915	33,907	122,194	13,364		[2] 19,435	(2)	26,118
1916	32,938	96,041	10,977	1,287	[2] 23,035	(2)	37,739
1917	27,869	87,331	8,231	1,369	[2] 25,478	(2)	44,102
1918	20,089	82,799	7,403	1,343	[2] 30,069	(2)	48,874
1919	30,085	109,005	9,068	1,350	[2] 32,362	(2)	46,739
1920	33,678	112,017	12,412	928	[2] 34,431	(2)	62,329
1921	26,738	143,545	11,568	463	21,805	381	41,909
1922	41,598	153,393	13,765	972	30,509	370	58,261
1923	37,786	125,087	11,949	800	38,037	646	75,107
1924	42,622	144,872	14,572	1,088	36,813	331	74,724
1925	43,426	120,479	14,996	1,090	41,669	840	86,546
1926	37,968	111,845	12,271	1,236	42,550	813	82,540
1927	38,669	119,026	13,482	1,061	39,073	709	81,655
1928	42,049	111,923	16,002	1,234	40,497	459	85,570
1929	42,159	104,872	15,580	1,234	43,021	678	87,916
1930	32,548	69,592	10,308	1,219	32,941	356	72,578
1931	30,922	66,446	8,790	896	25,853	282	63,890
1932	19,946	46,728	5,708	549	18,880	212	58,096
1933	24,628	48,354	7,320	625	21,988	231	61,193
1934	22,569	56,165	6,399	668	26,743	234	68,733
1935	27,972	68,859	7,572	727	28,776	252	79,930
1936	34,775	83,632	7,531	891	34,896	248	86,246
1937	32,661	65,552	7,514	1,108	33,931	206	83,902
1938	29,813	70,400	5,030	771	30,183	127	68,711
1939	30,509	67,920	4,688	850	39,976	131	89,518
1940	30,115	50,447	5,493	707	42,200	137	89,841
1941	54,689	58,311	8,739	1,631	53,838	246	122,280

[1] Small quantity of orange mineral included with red lead.
[2] Orange mineral included with red lead.

Zinc pigments and salts.—Sales of leaded zinc oxide established another new high record in 1941, and those of the lead-free class were the largest since 1929; the total of both grades had never been exceeded before. Lithopone sales, although not attaining a new peak, had been higher only from 1927 to 1929, inclusive. The sharp rise in the use of ore in the manufacture of zinc oxide was due primarily to the difficulty in obtaining adequate supplies of zinc metal and scrap in 1941. The average quoted price for lithopone in 1941 was above the range for 1940, but, in general, prices for various grades of zinc oxide were at or close to the top of the ranges for 1940. Producers reported receiving higher average values for all pigments during 1941.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1940–41

Pigment or salt	1940			1941		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	113,213	$13,361,980	$118	148,833	$18,558,474	$125
Leaded zinc oxide [1]	45,362	5,187,522	114	68,920	8,101,782	118
Lithopone	151,802	10,197,897	67	176,642	12,550,193	71
Zinc chloride, 50° B	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulfate	11,937	695,496	58	19,201	1,424,456	74

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide. [2] Data not available

Zinc pigments and salts sold by domestic manufacturers in the United States, 1910–41, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1910	58,481	6,823	12,655	(1)	(1)
1911	63,827	6,765	16,866	(1)	(1)
1912	84,002	11,410	24,220	(1)	(1)
1913	75,700	9,421	29,685	(1)	(1)
1914	82,809	11,317	32,819	(1)	(1)
1915	109,261	18,758	46,494	(1)	(1)
1916	100,339	23,003	51,291	(1)	(1)
1917	107,586	23,450	63,713	(1)	(1)
1918	100,286	26,714	62,403	(1)	(1)
1919	117,639	27,591	78,365	[2] 59,228	[2] 2,763
1920	99,444	30,460	89,373	[2] 68,945	[2] 3,072
1921	74,329	16,103	55,016	59,457	3,295
1922	128,465	19,613	83,360	41,627	5,078
1923	126,987	23,504	98,199	42,431	5,375
1924	131,470	26,729	109,469	51,054	4,674
1925	151,354	31,750	145,019	45,619	5,593
1926	146,923	23,859	159,931	47,296	6,612
1927	151,246	26,064	176,994	40,141	6,418
1928	160,904	24,223	200,468	45,669	4,733
1929	160,611	27,149	206,315	43,189	7,454
1930	119,142	17,279	164,065	29,043	6,249
1931	95,700	18,577	151,850	34,885	5,290
1932	72,250	14,305	121,667	23,524	4,252
1933	98,542	22,868	140,831	32,187	5,698
1934	87,088	20,506	145,565	19,614	7,379
1935	99,697	29,976	159,486	(3)	7,892
1936	126,800	40,512	158,319	(3)	9,721
1937	114,652	40,343	154,771	(3)	10,521
1938	79,129	38,216	125,746	(3)	7,757
1939	114,552	42,684	142,759	(3)	10,157
1940	113,213	45,362	151,802	(3)	11,937
1941	148,833	68,920	176,642	(3)	19,201

[1] No canvass.
[2] Figures represent production.
[3] Data not available.

Complete data covering the production of zinc chloride in recent years are not available owing to the absence of a reliable report from one producer, whose output is believed to have been large.

Sales of zinc sulfate established a second successive high in 1941—61 percent above the previous record, attained in 1940.

CONSUMPTION BY INDUSTRIES

White lead.—Total sales of white lead gained 40 percent over 1940, and the dry variety established a new high record. White lead in oil did not make a good showing in relation to other prosperous years for the pigments industry.

Normally about 95 percent of the white lead sold is used in the manufacture of paint. For the past 2 years, the percentage has been closer to 90 percent, although some of the quantities shown under "Other" may rightfully belong under the paint classification.

Early in 1942, the Federal Specification Board approved several Emergency Alternate Specifications, including one to cover three regular specifications, namely: TT–P–36a, Lead-Zinc; TT–P–101a, Titanium-Zinc and Titanium-Zinc-Lead; TT–P–156, Basic Carbonate White Lead. A single emergency paint to take the place of all three will be designated E–TT–P–101a, Titanium-Zinc and Titanium-Zinc-Lead, Outside, Ready-Mixed White Paint. Although the title implies two types, only the titanium-zinc-lead type is specified. It covers light tints as well as the white product. The composition requirements are: Pigment, minimum 63 percent, consisting of

titanium dioxide, minimum 10 percent; zinc oxide, minimum 24 percent; white lead, minimum 24 percent; sum of zinc oxide and white lead, minimum 48 percent; inert pigments, maximum 40 percent. A semi-chalk-resisting type of titanium dioxide is required.

Distribution of white lead (dry and in oil) sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Paint	93, 580	95, 018	92, 380	73, 137	100, 665
Ceramics	2, 506	1, 918	1, 767	3, 029	3, 704
Other	2, 127	3, 277	4, 282	4, 396	8, 631
	98, 213	100, 213	98, 429	80, 562	113, 000

Basic lead sulfate.—The outstanding use of basic lead sulfate is also in the manufacture of paint; 90 percent of the total was sold for that purpose in 1941. The increasing use of this pigment in making leaded zinc oxide has been noted in earlier chapters of this series. The practice assumed record-breaking proportions in 1941, when 12,000 tons were so used compared with the previous peak of 7,700 tons in 1939. These quantities are included in the totals for leaded zinc oxide but not in those for basic lead sulfate.

Distribution of basic lead sulfate sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Paints	8, 255	5, 024	5, 170	5, 593	9, 285
Rubber	213	91	140	128	200
Storage batteries	6	3	4	4	8
Other	148	683	224	475	877
	8, 622	5, 801	5, 538	6, 200	10, 370

Red lead.—Sales of red lead were record-breaking in 1941; they exceeded the previous peak in 1929 by 25 percent and fulfilled the promise of increased use made when it became evident that a tremendous expansion in plant construction to supply materials for war purposes would develop. Although sales to makers of storage batteries continued to represent the larger part of the total, they did not advance in the same ratio as sales to manufacturers of paints,which gained 68 percent.

An Emergency Alternate Federal Specification for Red-Lead-Base Ready-Mixed Paint, E–TT–P–86, changed the specifications for this paint to: Pigment, red lead (95 percent grade), minimum 40 percent; red iron oxide (70 percent Fe_2O_3), minimum 20 percent; zinc oxide, minimum 10 percent; extenders, remainder (magnesium silicate, aluminum silicate, silica, or mixtures).

Distribution of red lead sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Storage batteries	20, 275	19, 057	24, 709	26, 718	27, 405
Paints	10, 440	8, 698	11, 421	11, 949	20, 130
Ceramics	854	655	1, 123	1, 117	1, 593
Other	2, 362	1, 773	2, 723	2, 416	4, 710
	33, 931	30, 183	39, 976	42, 200	53, 838

Orange mineral.—This pigment is produced in very small quantities. Ink manufacture took the principal amount in 1941.

Distribution of orange mineral sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Ink manufacture	76	20	64	51	98
Color pigments	51	94	40	18	26
Other	79	13	27	68	122
	206	127	131	137	246

Litharge.—Sales of litharge made a new high record in 1941, owing largely to the sharp advance in its use for storage batteries (the largest consuming industry) and to noteworthy increases in sales to makers of ceramics, chrome pigments, and insecticides. Each of these industries took more litharge than ever before. On the other hand, its use in rubber and varnish manufacture, although greater than in 1940, had been exceeded in earlier years. Black oxide or suboxide of lead used by storage-battery manufacturers established successive peaks in 1939, 1940, and 1941. The total for 1941 was 61,000 tons compared with 53,000 in 1940 and 45,000 in 1939. Sales of black oxide are not included in Bureau of Mines totals for litharge.

Distribution of litharge sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Storage batteries	32,228	32,514	39,754	38,303	49,847
Insecticides	18,242	11,736	16,435	16,041	19,403
Ceramics	7,577	5,889	8,679	12,072	18,285
Chrome pigments	7,330	5,590	9,415	8,456	13,927
Oil refining	8,311	6,411	7,619	6,876	6,749
Rubber	1,659	880	1,404	1,590	3,968
Varnish	3,366	2,449	2,428	3,003	3,165
Linoleum	264	231	226	418	647
Other	4,925	3,011	3,558	3,082	6,289
	83,902	68,711	89,518	89,841	122,280

Zinc oxide.—Although zinc oxide sales were 31 percent above those in 1940, unlike some of the pigments that made new highs in 1941, they were exceeded by the totals for 1925 and for each of the 3 years 1927, 1928, and 1929. The demand for zinc oxide in the manufacture of rubber and ceramics broke all records. Gains were also registered in sales for paint manufacture and floor coverings and textiles, but the quantities did not represent the largest ever sold for these purposes. The inadequacy of zinc metal and scrap supplies in 1941 caused a sharp downturn in the proportion of French-process zinc oxide made in that year, and only 24 percent of the total was manufactured by that method; 76 percent was American-process zinc oxide. These percentages represent changes from the 36 and 64 percent, respectively, for 1940 and the 41 and 59 percent for 1939. It is impossible to say what zinc oxide sales would have been if enough zinc had been available to meet requirements for the manufacture of this product.

Provisions for a zinc oxide monthly pool, for allocation by the Director of Priorities, are discussed in the opening section of this

report. The maximum prices for various grades of zinc oxide, which the Office of Price Administration requested manufacturers to maintain beginning January 1, 1942, are discussed in the price section of this report.

A new plant for the manufacture of zinc oxide by direct flash fuming zinc concentrates was completed and put in operation by the Eagle-Picher Mining & Smelting Co. in January 1941 at Galena, Kans.; a second unit that doubled the capacity of the plant was constructed and went into production early in July. Production of zinc oxide was begun during the year by the Gulton Metals Refining Co. at Metuchen, N. J.

Distribution of zinc oxide sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Rubber	67,061	46,266	70,187	70,979	90,429
Paints	27,987	20,884	25,334	23,268	30,304
Ceramics	5,216	4,908	6,572	6,352	8,596
Floor coverings and textiles	9,019	3,030	5,641	4,752	6,991
Other	5,369	4,041	6,818	7,862	12,513
	114,652	79,129	114,552	113,213	148,833

Leaded zinc oxide.—This increasingly popular pigment continued to advance in 1941, and sales reached new heights—68,920 tons, or 52 percent above the previous high record for 1940. One factor in the large increase during 1941 is that virtually all the zinc content of this pigment comes from zinc ores and concentrates; consequently, gains in its production placed no strain on tight supplies of zinc metal and scrap. As usual, paint manufacturers took nearly all the leaded zinc oxide sold. The total shown for leaded zinc oxide in 1941 includes 12,000 tons of basic lead sulfate used to increase the lead content of the product; this tonnage is excluded from the basic lead sulfate totals to avoid duplication in reporting data for metals.

Distribution of leaded zinc oxide sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Paints	39,584	37,348	41,519	44,341	67,472
Rubber	97		1		1
Other	662	868	1,164	1,021	1,447
	40,343	38,216	42,684	45,362	68,920

Lithopone.—Lithopone statistics are reported upon the basis of the regular lithopone content of high-strength lithopone plus normal lithopone sold as such; before 1936, they were upon the basis of standard-strength plus high-strength product. Sales in 1941 were 16 percent above those in 1940 and with the exception of 1927–29 were the largest on record. Paints, varnish, and lacquers take the principal part of the total lithopone sold, and sales to such users increased 13 percent in 1941; this use took about 80 percent of the total in several years but only 77 percent in 1940 and 75 percent in 1941. Floor coverings and textiles have used 12 to 13 percent and rubber 2 to 3 percent of the total in recent years. Based upon somewhat

incomplete information, separation of the 1941 quantities shown in the following table for floor coverings and textiles indicates that 16,000 tons were used for linoleum and felt-base floor coverings and the remainder for coated fabrics and textiles (oil cloth, shade cloth, artificial leather, and similar products). Other sales in 1941 included 5,559 tons for paper and 2,301 tons for printing ink. Figures for an additional quantity for printing ink cannot be separated from the total figures for paints.

Plant capacity for the production of lithopone was reported to total 181,600 tons at the end of 1941.

Distribution of lithopone sales, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Paints, etc.	122,915	101,924	113,995	117,075	132,691
Floor coverings and textiles	20,194	15,400	17,429	18,738	21,114
Rubber	4,383	3,148	3,189	3,387	3,547
Other	7,279	5,274	8,146	12,602	19,290
	154,771	125,746	142,759	151,802	176,642

The use of ordinary-strength lithopone in the manufacture of titanated lithopone (which usually contains 15 percent TiO_2) reached a peak in 1937, when 19,400 tons were so used; in 1941, 14,100 tons were used for this purpose. The lithopone figures in the following table are included in the totals for ordinary lithopone in the preceding table.

Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1937–41, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1937	23,000	19,400	1940	18,100	15,200
1938	20,100	17,000	1941	16,800	14,100
1939	16,100	13,700			

Zinc sulfide.—Although zinc sulfide has been produced by four plants in the United States in recent years, one producer dominates the industry; therefore, the Bureau of Mines has not been at liberty to release data on this commodity. Only two plants were productive in 1941.

Zinc chloride.—The Bureau of Mines cannot report zinc chloride production as one producer, whose output is reputed to be large, has failed to supply reliable data.

Zinc sulfate.—Sales of zinc sulfate in 1941 exceeded by a wide margin the high record established in 1940, thus continuing the uptrend that began in 1933 and was interrupted only in 1938; the gain over 1940 was 61 percent. Of the 1941 total, 5,555 tons were indicated for chemical manufacture (including the medicinal trade), 5,170 for rayon, 3,038 for agricultural purposes, 1,422 for paints and varnish processing, 1,203 for glue manufacture, 502 for electrogalvanizing, 246 for flotation reagents, and 130 for textile printing and dyeing. The distribution of 1,935 tons was not reported.

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND ZINC SALTS

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such miscellaneous secondary materials as scrap and waste from various industrial processes. In 1941, 91 percent of the lead pigments were derived from pig lead and 9 percent from ore. The proportion for zinc pigments in 1941 was 74 percent from ore, 8 percent from slab zinc, and 18 percent from secondary materials.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1940–41, by sources, in short tons

Source	1940		1941	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Ore:				
Domestic	16,869	94,491	23,951	129,520
Foreign			290	2,464
Metal	196,235	19,421	248,674	15,463
Secondary material [2]		29,675	400	31,703
	213,104	143,587	273,315	179,150

[1] Includes also lead recovered in leaded zinc oxide.
[2] Zinc ashes, skimmings, drosses, and old metal.

The following tables give the source of the metal used in the manufacture of each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and is used also in the manufacture of basic lead sulfate. The lead content of leaded zinc oxide made from basic zinc sulfate, which in turn was made from pig lead, is credited to pig lead in the table. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulfate, and basic lead sulfate. A substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material. A decided increase has been noted in the quantity of secondary zinc consumed in the manufacture of zinc oxide since 1933. The relative scarcity of zinc metal and scrap in 1941 caused declines in the use of both these materials for the manufacture of zinc oxide in the face of a noteworthy gain in production of the pigment.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1940–41 by sources, in short tons

Pigment	1940: Lead in pigments produced from— Ore: Domestic	1940: Ore: Foreign	1940: Pig lead	1940: Secondary material	1940: Total lead in pigments	1941: Lead in pigments produced from— Ore: Domestic	1941: Ore: Foreign	1941: Pig lead	1941: Secondary material	1941: Total lead in pigments
White lead			69,535		69,535			86,750		86,750
Red lead			38,905		38,905			47,615		47,615
Litharge			85,005		85,005			112,099		112,099
Orange mineral			180		180			172		172
Basic lead sulfate	4,705		1,436		6,141	6,122		1,126	400	7,648
Leaded zinc oxide	12,164		1,174		13,338	17,829	290	912		19,031
	16,869		196,235		213,104	23,951	290	248,674	400	273,315

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1940–41, by sources, in short tons

Pigment or salt	1940: Zinc in pigments and salts produced from— Ore: Domestic	1940: Ore: Foreign	1940: Slab zinc	1940: Secondary material	1940: Total zinc in pigments and salts	1941: Zinc in pigments and salts produced from— Ore: Domestic	1941: Ore: Foreign	1941: Slab zinc	1941: Secondary material	1941: Total zinc in pigments and salts
Zinc oxide	59,463		18,696	15,148	93,307	87,999	373	15,435	12,826	116,633
Leaded zinc oxide	21,178		680	662	22,520	27,508	2,091		1,469	31,068
Lithopone	13,850		45	13,865	27,760	14,013		28	17,408	31,449
Zinc sulfide	(1)				(1)	(1)				(1)
Zinc chloride	(1)		(1)	(1)	(1)	(1)		(1)	(1)	(1)
Zinc sulfate	1,426			1,958	3,384	2,831			2,840	5,671

[1] Data not available.

PRICES

The total values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. The average reported values for all lead pigments, except white lead in oil and basic lead sulfate (blue), were above those for 1940 by $2 to $20 a ton; these two classes remained unchanged from 1940. Average price quotations for all lead pigments exceeded those for 1940, principally because they were near or at the top of the range for 1940 rather than because they actually exceeded the range for that year. Price changes for lead oxides, as usual, coincided with the price changes for the metal. White lead prices rose at the beginning of January 1941 and remained unchanged thereafter.

All values reported by producers for zinc pigments and salts were higher in 1941 than in 1940. On the whole, average price quotations also were higher than in 1940 because they clung to the higher part of the 1940 range. They were generally unchanged throughout 1941, although Pacific coast prices for lithopone, zinc oxide, and zinc

sulfide rose ¼, ½, and ½ cent a pound, respectively, in midyear. Prices for lithopone and zinc sulfide were advanced on the first day of 1941 but did not change subsequently. Zinc sulfate prices rose ½ cent a pound in June.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1938–41, in cents per pound

Product	1938	1939	1940	1941
Basic lead sulfate, or sublimed lead, less than carlots, barrels	5.50- 6.50	6.25- 6.50	6.25- 6.75	6.50- 7.00
White lead, or basic lead carbonate, dry, carlots, barrels	6.00- 7.00	7.00	7.00- 7.50	7.50
Litharge, commercial, powdered, barrels	5.50- 7.50	6.25- 7.75	6.25- 8.25	7.00- 8.25
Red lead, dry, 95 percent or less, less than carlots, barrels	7.00- 8.50	7.75- 9.00	7.75- 9.25	8.50- 9.25
Orange mineral, American, small lots, barrels	9.50-11.00	10.25-11.25	10.25-11.75	11.00-11.75
Zinc oxide:				
American process, lead-free, bags, carlots	6.25- 7.50	6.25- 7.50	6.25- 7.50	6.50
American process, 5 to 35 percent lead, barrels, carlots	5.90- 6.38	6.25- 6.38	6.25- 6.75	6.25- 6.75
French process, red seal, bags, carlots	7.50	7.50	7.50- 7.75	7.75
French process, green seal, bags, carlots	8.00	8.00	8.00- 8.25	8.25
French process, white seal, barrels, carlots	8.75	8.75	8.75- 9.00	9.00
Lithopone, domestic, 5-ton lots, bags	4.38- 4.63	4.00- 4.38	3.85- 4.00	4.10
Zinc sulfide, less than carlots, bags, barrels	8.63- 9.50	7.75- 8.88	7.75- 8.00	8.00- 8.25
Zinc chloride, works:				
Solution, tanks	2.25	2.25	2.25	2.25- 2.50
Fused, drums	4.25- 5.75	4.25- 5.75	4.25- 5.75	4.25- 6.50
Zinc sulfate, crystals, barrels	2.65- 4.05	2.90- 3.65	2.90- 3.90	3.15- 4.40

The favorable behavior of prices for lead and zinc pigments and zinc salts, in the face of the tremendous pressure of record-breaking sales and scarcity of raw materials, was in deference to the known Government desire to avoid price advances wherever possible throughout the war emergency.

In December zinc oxide producers were requested by the Office of Price Administration to agree individually to a list of maximum prices for their product. The O. P. A.-approved ceiling prices per pound for various grades of zinc oxide delivered in bags in carlots were 7.25 cents for lead-free American process oxide, 6.75 cents for leaded zinc oxides containing 35 percent or more lead, 7.125 cents for leaded zinc oxides containing less than 35 percent lead, 9.50 cents for lead-free French process oxides other than U. S. P., and 10.50 cents for French process U. S. P. oxide. Price schedule 80 of the Office of Price Administration, effective February 2, 1942, set a maximum price of 4.25 cents per pound for the normal grade of lithopone.

FOREIGN TRADE [1]

Any discussion of foreign trade in 1941 is necessarily restricted because data for October and subsequent months are held confidential by the Department of Commerce. Incomplete figures for imports fail to indicate anything unusual in that phase of foreign trade. It is noteworthy, however, that export values for the first 9 months of 1941 exceeded those for the full year 1940 in each group covered by the following table. Lithopone continued to be the outstanding item in the export class, whereas zinc oxide led again in the relatively unimportant import class.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1940–41

	1940		1941 (Jan.-Sept.)	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$249	$211, 148	$389	$279, 742
Red lead		185, 049	217	302, 239
Litharge	9	197, 634		250, 523
Orange mineral	140	(1)		(1)
Other lead pigments	13, 571	(1)	8, 546	(1)
	13, 969	593, 831	9, 152	832, 504
Zinc pigments:				
Zinc oxide	45, 347	472, 305	13, 413	858, 190
Lithopone		1, 112, 362	9	1, 454, 520
Zinc sulfide	693	(1)	1, 525	(1)
	46, 040	1, 584, 667	14, 947	2, 312, 710
Lead and zinc salts:				
Lead arsenate		242, 399		306, 853
Zinc chloride	1, 147	(1)		(1)
Zinc sulfate	7, 736	(1)	4, 216	(1)
	8, 883	242, 399	4, 216	306, 853
Grand total	68, 892	2, 420, 897	28, 315	3, 452, 067

[1] Data not available

Lead pigments and salts.—In 1941, as usual, imports of these commodities were insignificant.

Lead pigments and salts imported for consumption in the United States, 1937–41

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	
1937	34	1	(1)	5	213	[2] $53, 984
1938	20	1	1	2	85	[2] 22, 644
1939	11	2		1	104	[2] 28, 248
1940	2		(1)	1		[2] 13, 969
1941 (Jan.-Sept.)	2	2				[2] 9, 152

[1] Less than 1 ton.
[2] Includes also—1937: Lead pigments, n. s p. f , $8 (100 pounds), sublimed lead (basic sulfate), $2 (10 pounds), and suboxide of lead, n s. p f , $9,396 (55,453 pounds); 1938 Lead pigments, n. s. p. f , $198 (2,330 pounds), and suboxide of lead, n. s. p f , $5,335 (31,834 pounds); 1939· Lead pigments, n. s p. f., $690 (5,270 pounds), and suboxide of lead, n s p. f., $6,620 (40,445 pounds), 1940 Suboxide of lead, n s p. f., $13,571 (71,148 pounds), 1941 (Jan -Sept.)· Suboxide of lead, n s p f., $8,546 (52,040 pounds).

All export items covered by the following table had the same relative importance, as regards quantity, in the period January to September 1941.

Lead pigments and salts exported from the United States, 1937–41

Year	Short tons				Total value
	White lead	Red lead	Litharge	Lead arsenate	
1937	1, 236	934	1, 452	521	$677, 815
1938	1, 411	806	1, 694	511	605, 075
1939	2, 024	1, 324	2, 077	856	875, 285
1940	1, 360	1, 336	1, 586	1, 450	836, 290
1941 (Jan.-Sept.)	1, 976	2, 050	2 003	1, 875	1, 139, 357

Zinc pigments and salts.—No zinc pigment or salt was imported in significant amounts during 1941.

Zinc pigments and salts imported for consumption in the United States, 1937–41

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1937	680	95	5,601	113	667	593	$488,116
1938	579	66	3,932	12	272	392	321,445
1939	1,485	66	2,641	7	399	325	317,719
1940	273	45		(1)	19	245	54,923
1941 (Jan.-Sept.)	107	11	(1)	1		78	19,163

[1] Less than 1 ton.

Shipments of zinc pigments from the United States, like those of the lead group, were larger during the first 9 months of 1941 than in all of 1940. Lithopone continued to be the feature of the export trade in lead and zinc pigments; it was the largest single item in both quantity and value and established a new high record. Exports of zinc oxide in the first 9 months of 1941 were larger than in any calendar year since 1930.

Details covering exports in 1941, by countries, can be shown for the first 3 months only, and these are not sufficiently complete to be recorded separately here. As indicated by tables in the preceding chapter of this series, Canada normally receives the preponderant share of exports of lithopone, 55 percent of the total for the period 1936–40 having gone to that country. South American countries have taken increasing quantities of lithopone in recent years: they took 22 percent of the total in 1940. The pattern of exports of zinc oxide differs from lithopone in that the quantities shipped do not go so largely to only a few destinations. Canada is the destination of the largest part of the zinc oxide exported, having received 37 percent of the total for 1936–40. A relatively large tonnage has gone to Asiatic countries in recent years, and increasing quantities have gone to Mexico and Brazil.

Zinc pigments and salts [1] exported from the United States, 1937–41

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1937	2,953	2,671	$609,954	1940	3,239	14,298	$1,584,667
1938	1,163	1,734	339,415	1941 (Jan.-Sept.)	5,404	16,954	2,312,710
1939	3,485	4,845	925,468				

[1] Zinc salts not separately recorded.

GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

SUMMARY

Gold recovered from Alaska ores and gravels in 1941 totaled 695,467 fine ounces valued at $24,341,345—a decrease of 8 percent from the 755,970 ounces valued at $26,458,950 in 1940. The value of the gold in 1941 was 99 percent of the total gross value of the gold, silver, copper, and lead produced. The silver, lead, and most of the copper produced were byproducts of gold mining. The number of producing lode mines decreased from 73 in 1940 to 56 in 1941, floating connected-bucket dredges from 49 to 47, and other types of placer operations from 1,020 to 752.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938-41 Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers

[4] $0.64646464.

[5] $0.67878787.

[6] 0.71111111.

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1937–41 and 1880–1941 in terms of recovered metals; the output of gold and silver in 1941, by types of operation; and the output of gold, silver, copper, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1941, by regions.

Mine production of gold, silver, copper, and lead in Alaska, 1937–41, and total, 1880–1941, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
1937	627,940	$21,977,900	494,340	$382,372
1938	664,973	23,274,055	479,853	310,208
1939	676,737	23,685,795	201,054	136,473
1940	755,970	26,458,950	191,679	136,305
1941	695,467	24,341,345	191,522	136,193
1880–1941	25,152,030	593,335,652	19,562,668	13,915,671

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1937	34,672,000	$4,195,312	1,646,000	$97,114	$26,652,698
1938	29,098,000	2,851,604	1,988,000	91,418	26,527,315
1939	256,000	26,624	1,874,000	88,078	23,936,970
1940	110,000	12,430	1,558,000	77,900	26,685,585
1941	144,000	16,992	1,324,000	75,468	24,569,998
1880–1941	[1] 685,808	226,548,982	[1] 24,141	2,655,021	$836,455,326

[1] Short tons

Mine production of gold and silver in Alaska in 1941, by types of operation, in terms of recovered metals

Type of operation	Mines producing	Material treated	Gold			Silver			Total value
			Fine ounces	Percent of total		Fine ounces	Percent of total		
				1941	1940		1941	1940	
Lode mines	56	[1] 4,480,508	203,886	29	28	123,978	65	61	$7,224,172
Floating connected-bucket-dredges	[2] 47	[3] 23,405,479	307,087	44	47	38,943	20	25	10,775,738
Placers (dragline and dry-land dredges, hydraulic, drift mining, and sluicing)	[4] 752	([5])	184,494	27	25	28,601	15	14	6,477,628
	855		695,467	100		191,522	100		24,477,538
Total, 1940	1,142		755,970		100	191,679		100	26,595,255

[1] Short tons of ore.
[2] Number of dredges, including 1 single-dipper dredge.
[3] Cubic yards of gravel (average recovered per yard, $0.46).
[4] Includes all types and sizes of placer operations, excluding floating connected-bucket dredges.
[5] Cubic yards of gravel; figures not available.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1941, by regions, in terms of recovered metals

Region	Ore treated	Recovered in bullion: Gold	Recovered in bullion: Silver	Concentrates smelted and recovered metal: Concentrates produced	Concentrates smelted and recovered metal: Gold	Concentrates smelted and recovered metal: Silver	Concentrates smelted and recovered metal: Copper	Concentrates smelted and recovered metal: Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cook Inlet-Susitna	50,229	38,165	1,983	1,470	9,860	678	6,117	-------
Copper River	3,500	4,045	825	67	281	286	800	-------
Kenai Peninsula	1,066	869	270	-------	-------	-------	-------	-------
Kuskokwim	2,898	1,727	405	-------	-------	-------	-------	-------
Seward Peninsula	12	17	3	-------	-------	-------	-------	-------
Southeastern Alaska	4,365,678	105,357	24,281	2,331	21,907	76,701	72,094	1,314,000
Yukon River Basin	19,877	15,350	4,056	95	1,403	4,032	390	8,131
	4,443,260	165,530	31,823	3,963	33,451	81,697	78,901	1,322,131
Total, 1940	4,877,373	175,702	32,841	4,769	36,782	81,816	47,877	1,551,362

Gold.—Floating connected-bucket dredges recovered 44 percent of the total Alaska output of gold in 1941 compared with 47 percent in 1940. The United States Smelting, Refining & Mining Co., operating eight dredges at Fairbanks and four at Nome, was the largest producer of gold from this source in the Territory in both years. Placer mines worked by dragline and dry-land dredges, bulldozers and hydraulic giants, drifting, and sluicing together yielded 27 percent of the total gold in 1941 and 25 percent in 1940. A large part of the output from these types of operations came from the Circle, Fairbanks, Hot Springs, Iditarod (Flat), and Innoko (Folger, Ophir) districts. Lode mines contributed 29 percent of the total Alaska output of gold in 1941 and 28 percent in 1940. The Alaska Juneau Gold Mining Co. at Juneau continued to be much the largest producer of lode gold in Alaska. The Southeastern Alaska and Cook Inlet-Susitna regions yielded 88 percent of the total Alaska output of lode gold in 1941.

Silver.—All the silver produced in Alaska in 1941 was a byproduct of gold mining.

Copper.—The output of recoverable copper in Alaska in 1941 was only 144,000 pounds, of which 123,124 pounds were derived from gold ore and 20,876 pounds from copper ore.

Lead.—The bulk of the recovered lead output of Alaska in 1941 came from lead concentrates produced at the flotation mill of the Alaska Juneau Gold Mining Co.

MARKETS AND METALLURGY

About 94 percent of the gold and 52 percent of the silver produced from Alaska ores and gravels in 1941 were obtained in the form of gold-silver bullion, which was sold finally to the Seattle Assay Office and the San Francisco Mint. As there are no smelters or refineries in Alaska, all the remaining gold and silver produced and all the lead and copper were obtained from high-grade ore and concentrates shipped to smelters and refineries in the States, largely to the Tacoma (Wash.) and Selby (Calif.) smelters.

Banks and bullion buyers throughout the Territory and in Seattle, Wash., handled approximately 235,000 fine ounces of gold and 24,000 fine ounces of silver. The gold-silver bullion was either sent direct to the mints or cast into bars for shipping; in many instances the banks acted merely as agents for the lode and placer operations. The seven largest purchasers (or agents) of bullion (handling altogether over 229,000 fine ounces of gold) were: The Bank of Alaska, Anchorage; the Bank of Fairbanks and the First National Bank of Fairbanks, Fairbanks; the First National Bank of Valdez, Valdez; the Miners and Merchants Bank of Alaska, Nome; the Miners and Merchants Bank of Iditarod, Flat; and the Northern Commercial Co., Seattle, Wash.

Ore-reduction mills active in Alaska in 1941 included the 12,000-ton Alaska Juneau amalgamation-table concentration-flotation mill and about 45 other mills (chiefly amalgamation or cyanidation mills, with supplementary concentrating equipment) with reported daily capacities ranging from 2 to 72 tons. Most of the lead concentrates produced in 1941 were obtained by flotation of the dry gold ore of the Alaska Juneau Gold Mining Co. property at Juneau. Only 21 tons of copper concentrates were shipped during the year, and the small copper output of Alaska was derived mostly from gold ores. The concentrates shipped from straight concentration mills (1,720 tons) averaged 2.72 ounces of gold and 6.01 ounces of silver to the ton; those from amalgamation or cyanidation mills having concentrating equipment (3,963 tons) averaged 8 44 ounces of gold and 20.61 ounces of silver to the ton. The crude smelting ore shipped (76 tons) averaged 2.95 ounces of gold and 1.49 ounces of silver to the ton. Mill heads averaging more than 1 ounce of gold to the ton were not uncommon.

At the suggestion of miners, the United States Assay Office of the Treasury Department at Seattle, Wash., recommended that the districts in Alaska be redefined. In August and September 1941 the Denver Office of the Bureau of Mines, United States Department of the Interior, put the recommendation into effect in preparation for its 1941 canvass, and the preceding table and the "Review by regions" in this chapter follow the revised scheme. The Seattle Assay Office could not utilize the new districting during 1941, but in 1942 all receipts at that office will be listed in accordance with it.

Bullion of Alaska origin deposited at United States Assay Office, Seattle, Wash., during year ended December 31, 1941, in fine ounces

District	Gold	Silver	District	Gold	Silver
Circle	16, 497	1, 651	Kuskokwim	27, 323	1, 282
Cook Inlet	49, 457	1, 762	Nome	133, 034	11, 829
Copper River	7, 322	185	Southeastern Alaska	106, 180	22, 070
Eagle	3, 252	459	Tanana [1]	207, 740	28, 640
Iditarod	73, 652	4, 263			
Koyukuk	5, 956	583		630, 413	72, 724

[1] Includes mainly Bonnifield, Fairbanks, Hot Springs, Kantishna, and Tolovana districts in the Yukon Basin region.

REVIEW BY REGIONS

Cook Inlet-Susitna region.—This region, which includes the Iliamna, Valdez Creek, Willow Creek, and Yentna-Cache Creek districts, produced 24 percent of the total gold output from lode mines

in Alaska in 1941. There were 10 producing lode mines compared with 17 in 1940, and the output of gold decreased slightly.

The Alaska-Pacific Consolidated Mining Co., operating the Independence and Free Gold mines on the west branch of Fishhook Creek in the Willow Creek district, continued to be the largest producer of gold in the Cook Inlet-Susitna region and the second-largest producer of lode gold in Alaska. The mine is equipped with a 72-ton amalgamation-flotation mill, which was operated at capacity 7 days a week throughout the year. The ore treated averaged 1.29 ounces of gold and 0.07 ounce of silver to the ton. Mine development work resulted in 500 feet of shaft, 1,000 feet of drifts, 2,000 feet of tunnel, and 2,500 feet of diamond drilling.

The Willow Creek Mines Co., second-largest producer of gold in the Cook Inlet-Susitna region in 1941, maintained a steady output from its Lucky Shot mine and 60-ton amalgamation-flotation-cyanidation mill. The mine is on Cragie Creek approximately 1½ miles above the junction of Cragie Creek and Willow Creek and is connected with the mill by a ¼-mile aerial tram. Less gold-silver bullion and concentrates were shipped than in 1940. In treatment the ore is crushed and sent to a closed circuit, consisting of a ball mill, rake classifiers, and gold jigs. The jig concentrates are amalgamated. The classifier overflow passes into the flotation cells. The flotation concentrate goes to a regrind circuit (where more gold is amalgamated) and is then thickened, sacked, and shipped to the Tacoma (Wash.) smelter. The tails from the flotation cells are either sent to the cyanide plant or discharged into the creek.

Other leading lode-gold producers in the Cook Inlet-Susitna region were the Fern Gold Leasing Co. (operating the Fern, Goodel, and Talkeetna groups), the Gold Cord Development Co., Golden Zone Mine, Inc., and Mabelle Mines, Inc.

Placer operations, using principally hydraulic giants, recovered considerable gold from stream and bench gravels. Among the larger placer-gold producers were John E. Carlson and the White Creek Mining Co. in the Valdez district; and the Alaska Exploration & Mining Co., Cache Creek Mining Co., Devault, Devault & Seitz, Falls Creek Mining Co., Spokane Peters Creek Mining Co., and F. R. Wagner in the Yentna-Cache Creek district.

Copper River region.—The Copper River region includes the Chistochina, Nelchina, Nizina, Prince William Sound, and Yakataga (including Icy Bay) districts. The Cliff mine on Valdez Bay 10 miles west of Valdez, operated by Cliff Goldmines, Inc., was the principal producer of gold in the region in 1941. The mine is equipped with a 24-ton stamp amalgamation-gravity concentration mill which was operated 320 days and treated 2,500 tons of ore. The yield was 4,249 ounces of bullion containing 3,378 fine ounces of gold and 692 fine ounces of silver, and 36 tons of concentrates containing 81 ounces of gold and 21 ounces of silver. A plant for re-treating tailings by regrinding and flotation was nearly completed during the year. Other producers of lode gold included Yellow Band Gold Mines, Inc., in the Nizina district and the Sun Ray Mining Co. in the Prince William Sound district.

Placer gravels were worked, chiefly by hydraulicking and ground sluicing, in the Copper River region in 1941. Substantial producers of placer gold included J. M. Elmer on the Slate Creek Mining Co.

property and Einer Johnson on the Grubstake placer, both in the Chistochina district; Belanger, Cameron & Gallivan on Albert Creek in the Nelchina district; and Chititu Mines on the Rex Gulch property and Joshua Green Associates on Nicolai Placer Mines property in the Nizina district.

Kenai Peninsula region.—The Kenai Peninsula region includes the Moose Pass-Hope, Nuka Bay-Homer, and Turnagain Arm-Girdwood districts. No large producing lode or placer mines operated in this region in 1941. Most of the output of lode gold came from the Alaska Oracle Extension, East Point, and Gilpatrick mines in the Moose Pass-Hope district; the Paystreak mine in the Nuka Bay-Homer district; and the Crow Creek Gold Corporation property in the Turnagain Arm-Girdwood district. Among the producing placers were the Hope Mining Co. and Palmer Creek Mining Co. properties on Resurrection Creek in the Moose Pass-Hope district.

Kodiak Island region—Small quantities of gold were recovered by individuals from beach placering in 1941.

Kuskokwim region.—The Kuskokwim region includes the Bethel, Goodnews Bay, McGrath, and Tuluksak-Aniak mining districts. The only producing lode mine in the region in 1941 was the Nixon Fork in the McGrath district, owned and operated by Mespelt & Co.

Placers were worked in all the districts. Two floating connected-bucket dredges were operated in the Goodnews Bay district and two in the Tuluksak-Aniak district. Those in the Tuluksak-Aniak district were operated by the New York Alaska Gold Dredging Co., largest gold producer in the region in both 1941 and 1940. In the Goodnews Bay district the Bristol Bay Mining Co. operated its floating connected-bucket dredge (equipped with sixty-four 2½-cubic foot buckets) from May 9 to October 10, 1941, on Wattamuse, Slate, Culver, and Bear Creeks northerly from Goodnews Bay. The Goodnews Bay Mining Co. operated its dredge (equipped with ninety-two 8-cubic foot buckets) on Salmon River from April 26 to November 5. The company produced gold also from other ground on Salmon River and Platinum Creek and in Snow Gulch on the Arolic River, using 3-inch hydraulic giants, bulldozers, and draglines.

Among the other larger producers from dragline land dredge operations were Strandberg & Sons on Candle Creek in the McGrath district; the Marvel Creek Mining Co., Garrison Co., and Peandore Placer Mining Co. in the Tuluksak-Aniak district; John B. Huff on Butte Creek in the Arolic River area (hydraulicking); and the Eek River Mining Co. in the Bethel district.

Northwestern Alaska region.—Mining in the Northwestern Alaska region—comprising the Kiana and Shungnak districts and covering the area of the Kobuk River Valley—was confined mostly to small placer operations in 1941. The Lammers Exploration Co. shipped sizable lots of gold dust from its placer on California Creek (Shungnak district) to the Miners and Merchants Bank of Alaska at Nome.

Seward Peninsula region.—The Seward Peninsula region—comprising the Council-Bluff, Fairhaven, Kougarok, Koyuk, Nome, Port Clarence, and Serpentine River districts—had 22 floating connected-bucket dredges in 1941 (same number as in 1940); numerous bulldozer-hydraulicking, dragline land dredging, drift mining, and ground-sluicing operations; and only 1 small producing lode mine (the McDuffee, in the Nome district). Gold recovered by dredges increased 6 percent

over 1940. The average value of the gravel worked by dredges was about 47 cents per cubic yard compared with 50 cents in 1940. Most of the dredge operations in 1941 began in the period from May 10 to June 18 and ended in that from October 9 to November 23. Preparation of dredging ground is started well ahead of actual dredging, and in some places preparation of ground and general repair work are carried on throughout the year. Other types of placer operations averaged about 120 days for mines mechanically equipped.

The United States Smelting, Refining & Mining Co., in the Nome district, was the largest producer of gold in the region. The company operated three electrically powered Yuba dredges (one with 112, one with 103, and one with 78 9-cubic foot buckets) throughout the open season and in October completed and placed in operation a Yuba dredge equipped with 134 9-cubic foot buckets. Gravel washed in 1941 totaled approximately 4,000,000 cubic yards compared with 3,700,000 in 1940. The Thirty-sixth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1941 (dated March 19, 1942), says—

> At Nome, Alaska, three dredges operated throughout the normal season and the new deep-digging dredge referred to in last year's report was started in October. In all, the four dredges operated 593 dredge days in 1941 as against 567 dredge days in 1940. Both yardage and grade were better.

Arctic Circle Exploration, Inc., operated two dredges, each with seventy 4-cubic foot buckets, on Candle Creek in the Fairhaven district and ranked second in production of gold in the region in 1941.

Castleton & Keenan, operating a Washington Iron Works Diesel-powered dredge equipped with eighty-five 2¼-cubic foot buckets on the Kougarok River in the Kougarok district, began dredging June 18 and ceased October 10. The company also operated five hydraulic giants, three caterpillar bulldozers, and a dragline and washing plant on the Kougarok River.

Lee Bros. Dredging Co. operated two Diesel-powered floating connected-bucket dredges (one with 74 and one with 66 buckets) on the Solomon River in the Nome district from June to the middle of November and handled 750,000 cubic yards of gravel.

Other companies operating floating connected-bucket dredges in the Seward Peninsula region were: The Alaska Placer Co., Camp Creek Dredging Co., Council Dredging Co., Inland Dredging Co., and Ophir Gold Dredging Co., all in the Council-Bluff district; Dry Creek Dredging Co. and Forsgren Dredging Co., both operating on the Inmachuk River in the Fairhaven district; Fox Bar Dredging Co. in the Kougarok district; Ungalik Syndicate in the Koyuk district; and American Creek Dredging Co., Casa de Paga Gold Co., Osborn Creek Dredging Co., and Tolbert Scott, all in the Nome district.

Among the large producers of gold from placers worked by hydraulic giants, with some combination of bulldozers, draglines, and pumping equipment in addition, were: Crabtree & Sullivan in the Council-Bluff district; Wallace Porter in the Fairhaven district; The Alaska Taylor Mining Co., Carlson & Co., Dahl Creek Mining Co., Gold Bullion, Inc., Grant Mining Co., Rainbow Mines, Trinity Mining Co., George Waldhelm, and Wirum Bros., all in the Kougarok district; Gabe Johnson & Co., Gold Beach Placers, Margraf & Kowalski, E. W. Quigley, and C. O. Roberts, all in the Nome district; and Gilbert Fidjeland and Frank L. Rice, both in the Port Clarence district.

Southeastern Alaska region.—Southeastern Alaska—including the Admiralty Island, Chichagof Island, Hyder, Juneau, Ketchikan, and Windham Bay districts—produced 64 percent of the total lode gold and most of the silver, copper, and lead output of Alaska as a whole in 1941. There were 16 active mines—7 less than in 1940.

The Alaska Juneau was the largest producer of silver and lead and was second only to the United States Smelting, Refining & Mining Co. in output of gold in the Territory in 1941. The Twenty-seventh Annual Report of the Alaska Juneau Gold Mining Co. for the year ended December 31, 1941 (dated March 14, 1942), says—

During 1941 the amount of rock trammed from the mine was 4,354,770 tons. Compared to the previous year's production, this represents a decrease of slightly over 1,000 tons per day. The North ore body furnished 15 percent of the year's tonnage, the South ore body 38 percent, while the Perseverance section of the mine supplied 47 percent of the total.

During the year, 333,250 pounds of powder were used in blasting powder drifts; 33,750 pounds were used in blasting long hole stations, making a total of 367,000 pounds of powder for primary breaking, or 0.08 pound per ton trammed. Total powder consumption for primary and secondary breaking was 0.29 pound per ton trammed in 1941, as against 0.32 pound in 1940, and 0.32 pound in 1939. This gives a tonnage ratio of 3.45 tons of rock per pound of powder used for 1941, as against 3.13 tons in 1940.

In the Deep North ore body, work was started on ore pockets, skip loading apparatus, stations, and tipple installations in and around the Main shaft on 13 level, which is 1,450 feet below the collar of the winze. Work on the tipples and tunnel widening is still in progress but should be finished within a few months. Additional exploratory work was done in the western part of the Deep North ore body, while in the 91 winze area, ore-way raise work is still in progress.

While exploratory, development, and preparatory mining work was carried on throughout the year, the rate at which it was being done during the second half of the year was below the normal requirement. Any such prolonged curtailment of development and preparatory mining will directly affect future tonnage output, although the effect may be delayed somewhat, inasmuch as it generally takes about two years to bring a stope into production. This reduction of preparatory mining work is due to the shortage of labor and to the high turn-over of labor, both being results of the present national emergency.

Mill.—There were no alterations to the mill flow sheet during the year. The only additional equipment installed was a small Oliver filter, which handles a mixture of flotation and table concentrates.

Power plants.—The relocation of part of the Annex Creek electric transmission line was completed during the summer of 1941. The repair work at Salmon Creek Dam was continued, but due to labor shortage it was not completed.

Labor.—All during the year, except for the first 4 months, there was a very marked shortage of both skilled and unskilled labor in all departments. During the last few months of the year, we operated with 200 less men daily than during the previous year. Labor turn-over reached the highest point in the history of the mine. The average monthly percentage turn-over during the last 6 months was 10 percent, which is about three times greater than the normal turn-over.

In May 1941 a wage increase of about 7 percent was granted and a Union shop agreement was entered into with the Juneau Mine and Mill Workers Union affiliated with International Mine, Mill and Smelter Workers Union.

The average wage per day was $7.17 in 1941 as compared to $6.69 in 1940. The number of men employed at the end of the year was 866.

The over-all cost per man per day was $11.14 in 1941, as compared to $10.87 in 1940.

Gold content of ore from Alaska Juneau mine, 1937–41, and total, 1893–1941

Year	Rock to mill from mine (tons)		Gold (ounce)				
			Recovery per ton fine-milled		Losses per ton of tailings		Content of rock from mine to mill
	Ore fine-milled	Coarse tailings rejected	In bullion	In galena concentrates	Fine	Coarse	
1937	2,251,079	2,191,681	0 0594	0 0080	0 0116	0 0082	0 0441
1938	2,478,928	2,184,952	0515	0081	0090	0071	0398
1939	2,377,718	2,270,342	0454	0088	0083	0066	0352
1940	2,308,397	2,431,393	0442	0089	0081	0065	0331
1941	2,211,211	2,143,559	0451	0092	0078	0063	.0347
Total and average, 1893–1941	44,428,244	39,432,014	0507	.0114	0119	.0084	0432

Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1941

Year	Gold		Silver		Lead		Total value recovered
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1893–1913	34,239 49	$707,730 15	(1)	(1)	(1)	(1)	$707,730 15
1914–36	2,052,824 80	48,804,365 29	1,291,697 20	$754,495 04	29,468,743	$1,623,722 56	51,182,582 89
1937	151,670 64	5,308,471 55	120,691 21	91,528 49	1,980,405	116,414 16	5,516,414 20
1938	148,103 14	5,183,542 98	121,473 25	78,999 04	2,152,714	101,945 80	5,364,487.82
1939	129,011 74	4,515,410 28	111,494 24	75,165 90	2,040,280	104,961 22	4,695,537 40
1940	122,469 96	4,286,448 37	100,633 39	71,154 36	1,666,016	89,568 57	4,447,171 30
1941	120,501 24	4,217,897 67	95,776 56	67,753 89	1,464,956	85,268 93	4,370,920 49
Total	2,758,821 01	73,023,866 29	1,841,765 85	1,139,093 72	38,773,114	2,121,881 24	76,284,844 25

[1] Lost in tailings

Summary of production and operating costs, Alaska Juneau mine, 1914–41, inclusive

	4,354,770 tons		4,739,790 tons		83,353,004 tons	
	1941	Per ton trammed	1940	Per ton trammed	1914–41	Per ton trammed
Production (gross recovered gold, silver, and lead values)						
Bullion	$3,509,421 76	$0 806	$3,584,827 33	$0 756	$60,095,156 36	$0 721
Concentrates	861,498 73	198	862,343 97	182	15,481,957 74	186
	4 370,920 49	1 004	4,447,171 30	938	75,577,114 10	907
Costs						
Mining	1,649,946 97	379	1,744,652 26	368	25 173,771 89	302
Milling	1,005,054 65	231	1,069,494 51	226	20,181 013 53	242
Other Juneau operating and marketing costs	265,220 42	061	212,896 29	045	4,002,545 17	048
General corporation and pay-roll taxes	220,705 62	051	236,678 76	050	1,727,599 01	.021
Total Juneau operating and marketing costs	3,140,928 68	722	3,263,721 82	689	51,084,929 60	613
All other costs	77,531 84	018	59,422 14	013	3,538,655 62	042
Total operating costs and expenses	3,218,460 50	740	3,323 143 96	702	54,623,585 22	655
Juneau operating profit	1,229,991 83	282	1,183,449 48	249	24,492,184 50	294
Net operating profit	1,152,459 99	264	1,124,027.34	236	20,953,528 88	252
Other revenue (interest, etc)	50,504 47		41,052 43		719,652 38	
Profit before depreciation, depletion, and income taxes	1,202,964.46		1,165,079 77		21,673,181 26	

The Hirst-Chichagof Mining Co. on Chichagof Island operated its mine and 35-ton amalgamation-flotation mill continuously in 1941 and was again the second-largest producer of gold in the region. The bullion product was sent direct to the Seattle Assay Office, and the concentrates were shipped to the Tacoma (Wash.) smelter.

The Chichagof Mining Co. at Klag Bay in the Chichagof Island district continued to treat old tailings, producing gold-silver concentrates (containing a little copper) which were shipped to the Tacoma (Wash.) smelter.

The output from other mines in the region was small. Companies or individuals producing more than 100 ounces of gold from lode mines were the Alaska Empire Gold Mining Co. in the Admiralty Island district, the LeRoy Mining Co. in the Juneau district, and Wendell Dawson in the Ketchikan district. Small sluicing operations in the Juneau and Windham Bay districts recovered placer gold.

Yukon River Basin region.—The Yukon River Basin region includes the following mining districts: Bonnifield-Nenana, Chandalar, Chisana, Circle, Delta River, Eagle, Fairbanks, Fortymile, Goodpaster, Hot Springs, Hughes, Iditarod, Innoko, Kantishna, Koyukuk, Marshall, Rampart, Ruby, Tolovana, and Yukon Flats. The region yielded 59 percent of the total output from connected-bucket dredges in Alaska during 1941; it ranked first in gold recovered from other placers and third in that from lode mines.

Twenty-two floating connected-bucket dredges (including one single-dipper dredge) were operating in the region—two less than in 1940.

The United States Smelting, Refining & Mining Co., operating eight floating connected-bucket dredges in the Fairbanks district, was much the largest producer of gold and silver in the Yukon River Basin region. The company operated two 10-cubic foot Bethlehem dredges (with 111 and 93 buckets, respectively), one 10-cubic foot Yuba dredge (with 106 buckets), three 6-cubic foot Bethlehem dredges (with 78, 78, and 68 buckets, respectively), one 5-cubic foot Yuba dredge (with 84 buckets), and one 3-cubic foot Yuba dredge (with 68 buckets); all the dredges are electrically operated. Other equipment used (chiefly for removing overburden) included 365 Joshua Hendy hydraulic giants, one 8- to 12-cubic yard electric-powered Bucyrus 10-W dragline, and one oil-burning caterpillar bulldozer. Of the dredges operated in 1941, two were on Cleary Creek, two on Goldstream Creek, and one each on Cripple, Ester, Fish, and Pedro Creeks.

The Thirty-sixth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1941 (dated March 19, 1942), says—

At Fairbanks, Alaska, the gold output for the season was considerably lower than in 1940. This was due to a strike which lasted from June 6 to July 2, 1941, shutting down all operations and resulting in a loss of 216 dredge days for the eight dredges; and to decrease in the output of the new large dredge, which spent most of the season of 1941 digging in tailings and lower-grade gravels. In all, the dredges operated 1,611 dredge days in 1941 as against 1,799 dredge days in 1940.

At both Fairbanks and Nome there were further acquisitions of ground in 1941. Continued development resulted in gold-reserve additions which considerably exceeded the year's extraction.

In the Circle district three dredges were again active in 1941. Alluvial Golds, Inc., operated its W. W. Johnson Co. dredge (with

seventy-two 4-cubic foot buckets) on Woodchopper Creek. On Coal Creek, Gold Placers, Inc., ran a dredge of similar type equipped with sixty 4-cubic foot buckets. The C. J. Berry Dredging Co. operated its steampowered dredge (with fifty-eight 3-cubic foot buckets) and handled about 318,200 cubic yards of gravel. The output by these three dredges ranked the Circle district second in gold produced by dredges in the Yukon River Basin in 1941.

The Tolovana district, with two dredges, ranked third in the region in gold produced by dredges. Livengood Placers, Inc., made a large output from its Yuba dredge on Livengood Creek, equipped with eighty-eight 6-cubic foot buckets. The Nome Creek Mining Co. operated a W. W. Johnson Co. dredge (with 4-cubic foot buckets) on Nome Creek northeast of Fairbanks.

In the Iditarod district the North American Dredging Co. operated a Washington Iron Works dredge (with sixty-nine 3-cubic foot buckets) on Otter Creek from May 19 to November 5. The Riley Investment Co. also operated a dredge on Otter Creek.

Three dredges were active in the Innoko district in 1941; the Ganes Creek Dredging Co. and Moss & Larson operated one each on Ganes Creek, and Nels J. Vibe ran one on Yankee Creek.

In the Fortymile district the Boundary Dredging Co. operated a W. W. Johnson Co. 60-bucket dredge on Canyon Creek from July 22 to October 12. On Wade Creek the Wade Creek Dredging Co. continued to operate its Risdon steam-powered dredge equipped with seventy 3½-cubic foot buckets.

In the Bonnifield-Nenana district Standard Mines, Inc., operated a Becker-Hopkins single-bucket floating dredge on Eva Creek. The bucket is mounted on a steel framework at the digging end of the dredge in such a manner as to permit it to be elevated to an angle that allows the gold-bearing gravel to be discharged into a trommel screen on the floating washing plant. The washing plant and stacker unit are similar to those on lightweight connected-bucket dredges.

On Caribou Creek in the Delta River district the Brinker-Johnson Co. operated its W. W. Johnson Co. dredge, equipped with seventy-eight 4½-cubic foot buckets, from June 15 to November 7, 1941.

Placer operations of all types—other than floating connected-bucket dredges—were to be found throughout the Yukon River Basin region, some with production as large as or larger than the average dredge and many producing over 500 ounces of gold. The combined production of these operations was at least 100,000 fine ounces of gold in 1941.

In the Bonnifield-Nenana district Triple X Placers operated a 1½-cubic yard Bucyrus dragline, an Isaacson washing plant, and two caterpillar bulldozers on the Totatlanika River from June 1 to September 25 and handled 200,000 cubic yards of gravel.

Among the larger producers in the Circle district using hydraulic giants and bulldozers or draglines with screening and sluicing plants were: The Berry Holding Co., Bergstrom & Savage, Central Mining Co., Frank & Co., Independence Mining Co., F. B. Johnston Mining Co., Jack LaCross, and Mastodon Mining Co.

In the Fairbanks district Helmer Johnson handled approximately 35,000 cubic yards of gravel with hydraulic giants and a bulldozer at his placer on upper Cleary Creek; the yield was 1,157 fine ounces of gold and 190 fine ounces of silver. The Wolf Creek Mining Co.,

operating a dragline and washing plant on Wolf Creek, continued to be an important producer of gold. The Fish Creek Mining Co. on upper Fish Creek and the Faith Creek Mining Co. on Faith Creek (tributary to Chatanika River) recovered substantial quantities of gold by hydraulicking, bulldozing, and sluicing. The First Chance Mining Co. worked its claim in First Chance Creek 14 miles from Fairbanks from March 25 to October 10, using six hydraulic giants, a Diesel-powered 1-cubic yard dragline, and a bulldozer; the gravel handled (100,000 cubic yards) had an average value of 15 cents a cubic yard, based upon net returns from the gold and silver sold. Other sizable producers in the Fairbanks district included the Alder Creek Mining Co., Brown & Reeves, the Gilmore Mining Co., O. M. Grant, Robert O. Jones, and J. H. Martin.

In the Fortymile district the Central Development Syndicate continued to be an important producer of gold from company owned and leased ground on Jack Wade Creek; hydraulic giants and bulldozers were used to handle the gravel.

Among the larger placer operators in the Hot Springs district were the Cleary Hill Mines Co., operating 12 hydraulic giants, 1 dragline, and 2 bulldozers on Sullivan Creek; J. R. Frank & Co. and Whitehead & Co., hydraulicking on Pioneer Creek; and the Montana Mining Co., using hydraulic giants with a dragline and bulldozer on Omega Creek.

On Utopia Creek (tributary to Indian River) in the Hughes district L. McGee handled 200,000 cubic yards of gravel, using four hydraulic giants, two bulldozers, and a dragline in conjunction with a land washing plant; the average value of the gravel was 43.5 cents a cubic yard. McGee also worked ground on Black Creek and Indian River with hydraulic giants and bulldozers; the gravel washed (45,000 cubic yards) had an average value of 51.3 cents a cubic yard.

In the Iditarod district the larger producers from these types of placer operations were: The Awe Mining Co., the Granite Mining Co., Hatten, Bauquier & Turner, Sakow & Tomoff, Turner & Remington, and Uotila & Ogriz.

In the Innoko district Three Miners, Inc., operated its dragline and portable dry-land washing plant on the Innoko River about 30 miles northwest of Ophir from March 15 to September 30, 1941. Degnan & Rosander and the Cripple Creek Mining Co operated similar equipment on Little Creek and Cripple Creek, respectively. Hard, Uotila & Hansen operated seven hydraulic giants, a 1½-cubic yard dragline, and a bulldozer on Bear Creek from April to October. Other large placer operators were Beaton & McDougall, Peter Miscovich & Sons, the Moore Creek Mining Co., Sid Paulson, and Savage & Matheson.

On Caribou Creek in the Kantishna district Caribou Mines handled 119,668 cubic yards of gravel from June 20 to September 16, using a 1½-cubic yard dragline, two bulldozers, and a dry-land washing plant, all of which used oil for fuel

The principal producer of gold in the Koyukuk district in 1941 was Repo & Schwaesdall, who operated hydraulic giants, bulldozers, and a dragline on Myrtle Creek.

In the Marshall district the Wilson Creek Mining Co operated its dragline and two bulldozers in conjunction with elevated sluices on Elephant Creek (tributary to Wilson Creek) from April 21 to October 21 and handled 235,888 cubic yards of gravel having an average value

of 25.6 cents a cubic yard. The Yukon Mining Co. mined from June 18 to October 11 on placer ground on Buster and Windy Creeks; sluicing was done on bedrock, and a dragline was used to stack the tailings. H. Roy Hunter operated two hydraulic giants, a dragline, and two bulldozers from June 1 to October 15 on Willow Creek 12 miles southeast of Fortuna Ledge

Other large producers among these types of placer operations in the Yukon River Basin region in 1941 were the Long Creek Mining Co and Richardson & Johnson in the Ruby district, and Parker & Son and A. W. Warwick in the Tolovana district.

Lode mining in the Yukon River Basin region produced 16,763 fine ounces of gold and 8,114 fine ounces of silver in 1941, decreases of 17 percent in gold and 5 percent in silver from 1940.

The leading producer of lode gold in the region in 1941 was Cleary Hill Mines, Inc., operating the Cleary Hill mine and amalgamation-flotation mill in the Fairbanks district 27 miles northeast of Fairbanks. The United States Smelting, Refining & Mining Co. operated its McCarty mine on Fairbanks Creek continuously in 1941, except during a strike which lasted nearly a month; the mine is equipped with a 10-ton amalgamation mill. The Hi Yu Mining Co. continued small-scale mining at its Hi Yu mine on Fairbanks Creek; the ore was treated in the 50-ton amalgamation mill on the property. Other small lode-gold producers in the Fairbanks district included the Carver Alder Mine Co., Emma Creek Mine Co. (a partnership), O. M. Grant, Lloyd Lounsberry, and the Tolovana Mining & Milling Co.

In the Kantishna district the Red Top Mining Co. operated its Red Top mine and 50-ton jig-, table-, and flotation-concentration mill from March 3 to October 26; the jig and table concentrates are amalgamated in a barrel, and the barrel tails and the flotation concentrates are shipped to the Tacoma (Wash.) smelter.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

SUMMARY

The total value of the output of recoverable metals from mines in Arizona was $97,638,310 in 1941 compared with $82,167,759 in 1940—an increase of 19 percent (see fig. 1); it was the greatest since 1929, when the total value was $155,567,133. Both quantity and value of each of the five metals increased substantially in 1941. The total value of the gold was $11,038,720, a 7-percent gain over 1940; silver $5,332,096, a 6-percent gain; copper $77,010,812, a 21-percent gain; lead $1,782,732, a 34-percent gain; and zinc $2,473,950, a 27-percent gain. The value of the gold production represented 11 percent of the State total, silver 5 percent, copper 79 percent, lead 2 percent, and zinc nearly 3 percent. The total value of the metals recovered from copper ore was $84,957,995 in 1941, or 87 percent of the State total. The output of copper in 1941 was the greatest since 1929, and the outputs of both lead and zinc were the largest in the history of the State. The output of placer gold (11,931 fine ounces) was larger than in any year since records were established in 1901 and resulted chiefly from the operation of two dragline-floating dredges in Yavapai County.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.101	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1937. Yearly average weighted Treasury buying price for newly mined silver, 1938–41. Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–41, and total, 1860–1941, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	888	376	20, 976, 359	332, 694	$11, 644, 290	9, 422, 552	$7, 288, 344
1938	885	329	14, 203, 164	305, 043	10, 676, 505	7, 479, 153	4, 835, 008
1939	976	142	18, 793, 260	316, 453	11, 075, 855	7, 824, 004	5, 310, 839
1940	1, 024	276	21, 572, 175	294, 807	10, 318, 245	7, 075, 215	5, 031, 264
1941	805	184	25, 491, 794	315, 392	11, 038, 720	7, 498, 260	5, 332, 096
1860–1941			(1)	10, 174, 289	243, 595, 270	268, 688, 038	199, 881, 769

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	576, 956, 000	$69, 811, 676	24, 708, 000	$1, 457, 772	10, 052, 000	$653, 380	$90, 855, 462
1938	421, 594, 000	41, 316, 212	21, 142, 000	972, 532	11, 628, 000	558, 144	58, 358, 401
1939	524, 224, 000	54, 519, 296	21, 542, 000	1, 012, 474	13, 422, 000	697, 944	72, 616, 408
1940	562, 338, 000	63, 544, 194	26, 532, 000	1, 326, 600	30, 912, 000	1, 947, 456	82, 167, 759
1941	652, 634, 000	77, 010, 812	31, 276, 000	1, 782, 732	32, 986, 000	2, 473, 950	97, 638, 310
1860–1941	[2] 9, 446, 796	2, 841, 255, 216	[2] 282, 054	32, 499, 650	[2] 126, 303	19, 142, 801	3, 336, 374, 706

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Arizona, 1937–41, in fine ounces, in terms of recovered metals

Year	Sluicing [1]		Drift mining		Dredges				Total	
					Dry-land [2]		Dragline floating [2]			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1937	1, 275	212	258	34	(3)	(3)	[3] 2, 866	[3] 403	4, 399	649
1938	1, 624	213	328	35	(3)	(3)	[3] 3, 033	[3] 380	4, 985	628
1939	1, 919	227	1, 850	125	(3)	(3)	[3] 2, 640	[3] 339	6, 409	691
1940	1, 625	207	646	41	1, 186	464	2, 784	396	6, 241	1, 108
1941	976	125	77	5	824	717	10, 054	1, 358	11, 931	2, 205

[1] Includes placer sands treated by dry concentration plants
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge "
[3] Figures for dragline floating dredges include those for dry-land dredges

Gold.—The output of recoverable gold in Arizona in 1941 was 315,392 fine ounces—an increase of 7 percent over 1940. Gold from siliceous ores (chiefly dry and siliceous gold ore) and zinc-lead ore was virtually the same as in 1940, but gold from copper ore increased 13,778 ounces and that from lead ore 1,234 ounces. Gold from placers increased 5,690 ounces; 84 percent of the total placer gold was recovered by dragline dredging at properties on Big Bug Creek and Lynx Creek in Yavapai County. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation continued to be the leading gold producer in Arizona; it was followed by the New Cornelia mine in Pima County, the Mammoth-St. Anthony Limited property in Pinal County, the Goldroad mine (United States Smelting, Refining

& Mining Co.) in Mohave County, and the United Verde mine in Yavapai County; these five properties produced more than 58 percent of the State total output. Other large gold producers were the Magma mine in Pinal County, the Octave mine (American Smelting & Refining Co.) in Yavapai County, the Shattuck Denn mine in Cochise County, the Iron King mine in Yavapai County, the Tyro mine (Gold Standard Mines Corporation) in Mohave County, and the

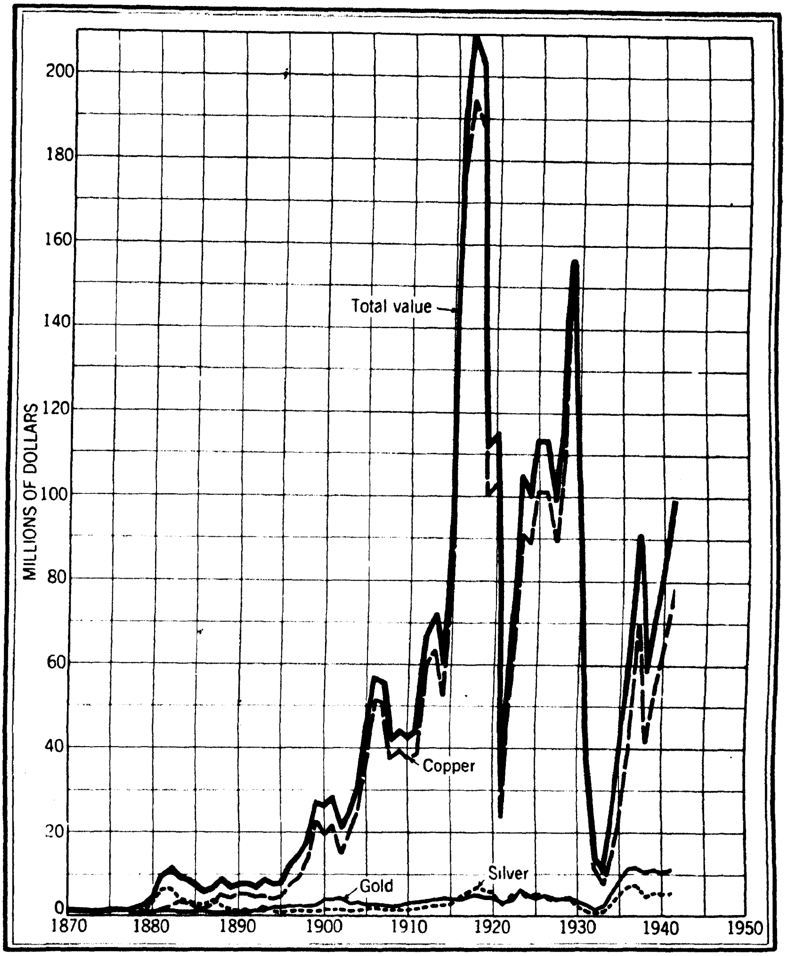

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1941. The value of lead and zinc has been less than $2,000,000 annually, except in a few years.

Congress property in Yavapai County. Siliceous ores yielded 46 percent of the State total gold, copper ore 45 percent, and zinc-lead ore 4 percent. The chief gold-producing districts in Arizona were the Warren (mostly copper ore), San Francisco (nearly all gold ore), Ajo (copper ore), Verde (mostly copper ore), Old Hat (nearly all gold ore), Weaver (Yavapai County) (gold ore), and Big Bug (mostly zinc-lead ore and placer gold).

Silver.—The output of recoverable silver in Arizona in 1941 was 7,498,260 fine ounces—an increase of 6 percent over 1940. Silver from siliceous ores declined 182,504 ounces and that from zinc-lead ore 48,992 ounces; but silver from copper ore increased 542,672 ounces, that from lead ore 62,609 ounces, and that from zinc-copper ore 32,600 ounces. Copper ore yielded 67 percent of the State total silver, siliceous ores 16 percent, zinc-lead ore 12 percent, zinc-copper ore 3 percent, and lead ore nearly 2 percent. The Phelps Dodge Corporation continued to be the chief silver producer in Arizona, and its output was 17 percent greater than in 1940; its four properties (Copper Queen, Morenci, New Cornelia, and United Verde) produced 40 percent of the State gold output, 54 percent of the silver, and 53 percent of the copper. Other large silver producers in Arizona in 1941 were the Magma, Shattuck Denn, Trench-Flux, Iron King, and Iron King-Equator properties. The chief silver-producing districts were the Warren (Bisbee), Verde (Jerome), Pioneer (Superior), Ajo, Harshaw, Big Bug, and Wallapai (Chloride); more than 56 percent of the total silver came from the Warren and Verde districts.

Copper.—The output of recoverable copper in Arizona in 1941 was 652,634,000 pounds—a 16-percent gain over 1940 and the largest output since 1929, when it was 830,628,411 pounds. There was a substantial increase in each of the seven chief copper-producing districts. The Globe-Miami district, with a production of 164,837,300 net pounds of copper, continued to be the leading copper-producing area in Arizona; it was followed by the Ajo district with 131,760,000 pounds, Warren (Bisbee) with 113,184,100 pounds, Mineral Creek (Ray) with 84,800,000 pounds, Verde with 84,484,800 pounds, Pioneer (Superior) with 38,238,400 pounds, and Copper Mountain (Morenci) with 27,757,800 pounds. These seven districts contributed 99 percent of the State total copper. Copper ore and its products yielded 647,420,204 pounds of copper, as follows: 18,607,089 tons of copper ore treated by concentration yielded 58 percent; 1,760,740 tons of copper ore shipped crude to smelters, 24 percent; and 3,785,654 tons of copper ore leached and 21,373 tons of cement copper (from mine-water precipitates and underground leaching operations), 18 percent. The New Cornelia property continued to be the largest copper producer in Arizona; it was followed in order by the Copper Queen, Inspiration, Ray (Nevada Consolidated Copper Corporation), United Verde, Miami, Magma, and Morenci (Phelps Dodge Corporation).

Lead and zinc.—The output of recoverable lead in Arizona in 1941 was 31,276,000 pounds—the largest output in any year in the history of the State and an increase of 18 percent over 1940; the output of recoverable zinc was 32,986,000 pounds—also the largest in any year in the history of the State and an increase of 7 percent over the record output in 1940. About 40 percent of the State total lead and 32 percent of the zinc came from Santa Cruz County, nearly 16 percent of the lead and 14 percent of the zinc from Mohave County, and 15 percent of the lead and 25 percent of the zinc from Pinal County; nearly all the remainder of the lead and zinc came from Yavapai and Cochise Counties. About 68 percent of the total lead and 74 percent of the total zinc came from zinc-lead ore; nearly all the rest of the lead came from siliceous ores, lead ore, zinc-copper ore, and copper ore, and nearly all the rest of the zinc from zinc-copper

ore. The Trench-Flux group of the American Smelting & Refining Co. near Patagonia in Santa Cruz County was by far the largest producer of lead in the State; it was followed by the Tennessee mine at Chloride, Mammoth-St. Anthony Limited property at Tiger, Shattuck Denn mine at Bisbee, Duquesne property near Patagonia, Hillside mine near Hillside, "79" mine near Hayden Junction, and Iron King mine at Humboldt. The largest producer of zinc in the State was the Magma mine at Superior; it was followed by the Trench-Flux, Tennessee, Shattuck Denn, Iron King, Duquesne, and Hillside properties.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise	35	2	63,441	$2,220,435	2,763,616	$1,965,238
Coconino	4		7	245	502	357
Gila	48	6	2,716	95,060	111,593	79,355
Graham	5		16	560	12,728	9,051
Greenlee	12	1	1,646	57,610	161,415	114,784
Maricopa	49	9	5,902	206,570	46,035	32,736
Mohave	193	7	56,203	1,967,105	285,875	203,289
Pima	56	6	42,252	1,478,820	461,053	327,860
Pinal	54	2	44,562	1,559,670	947,174	673,546
Santa Cruz	49		709	24,815	510,660	363,136
Yavapai	237	108	95,788	3,352,580	2,145,316	1,525,558
Yuma	63	43	2,150	75,250	52,293	37,186
	805	184	315,392	11,038,720	7,498,260	5,332,096
Total, 1940	1,024	276	294,807	10,318,245	7,075,215	5,031,264

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	113,346,000	$13,374,828	3,535,000	$201,495	4,280,000	$321,000	$18,082,996
Coconino	139,000	16,402					17,004
Gila	166,453,000	19,641,454	1,342,000	76,494	85,600	6,420	19,898,783
Graham	44,500	5,251	334,000	19,038			33,900
Greenlee	27,762,000	3,275,916	90,000	5,130	154,400	11,580	3,465,020
Maricopa	112,000	13,216	118,300	6,743			259,265
Mohave	221,500	26,137	4,851,000	276,507	4,692,000	351,900	2,824,938
Pima	133,141,000	15,710,638	65,000	3,705			17,521,023
Pinal	123,124,000	14,528,632	4,790,700	273,070	8,278,000	620,850	17,655,768
Santa Cruz	817,000	96,406	12,616,000	719,112	10,637,000	797,775	2,001,244
Yavapai	87,402,000	10,313,436	3,216,000	183,312	4,859,000	364,425	15,739,311
Yuma	72,000	8,496	318,000	18,126			139,058
	652,634,000	77,010,812	31,276,000	1,782,732	32,986,000	2,473,950	97,638,310
Total, 1940	562,338,000	63,544,194	26,532,000	1,326,600	30,912,000	1,947,456	82,167,759

Gold and silver produced at lode mines in Arizona in 1941, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Cochise	1,217,357	63,435	2,763,616
Coconino	1,060	7	502
Gila	9,958,665	2,705	111,593
Graham	2,686	16	12,728
Greenlee	918,777	1,637	161,415
Maricopa	76,469	5,870	46,028
Mohave	352,924	56,044	285,854
Pima	7,720,119	42,234	461,053
Pinal	3,502,114	44,559	947,174
Santa Cruz	97,607	709	510,660
Yavapai	1,637,696	84,934	2,143,831
Yuma	6,320	1,311	51,601
	25,491,794	303,461	7,496,055
Total, 1940	21,572,175	288,566	7,074,107

Gold and silver produced at placer mines in Arizona in 1941, by counties, in fine ounces, in terms of recovered metals

County	Sluicing [1]		Drift mining		Dredges				Total	
					Dry-land [2]		Dragline floating [2]			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Cochise	6								6	
Gila	11								11	
Greenlee	9								9	
Maricopa	32	7							32	7
Mohave	159	21							159	21
Pima	18								18	
Pinal	3								3	
Yavapai	484	75			316	52	10,054	1,358	10,854	1,485
Yuma	254	22	77	5	508	665			839	692
	976	125	77	5	824	717	10,054	1,358	11,931	2,205
Total, 1940	1,625	207	646	41	1,186	464	2,784	396	6,241	1,108

[1] Includes placer sands treated by dry concentration plants.
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

The mining industry continued to improve in Arizona in 1941, as a result of the demand for copper, lead, and zinc; more ore was mined than in any year (except 1929) in the history of the State. The output of copper ore increased to 24,153,483 tons—a 19-percent gain over 1940—but the output of zinc-lead ore declined to 260,473 tons—a 4-percent loss; however, the production of both lead and zinc was the largest ever recorded in the State. A total of 23,994,259 tons (94 percent of the State total ore output) was copper ore mined in the Globe-Miami, Ajo, Mineral Creek (Ray), Verde (Jerome), Warren (Bisbee), Copper Mountain (Morenci), and Pioneer (Superior) districts; virtually all the zinc-lead ore was mined in the Big Bug, Harshaw, Wallapai (Chloride), Eureka (Hillside), Patagonia, and Warren (Bisbee) districts. The output of siliceous ores (chiefly gold ore) increased to 975,790 tons—a 5-percent gain over 1940 and lead ore to 18,432 tons—a 109-percent gain; zinc-copper ore increased slightly to 80,810 tons. Placer mining, chiefly dredging operations, was the greatest in any year since records were established in 1901.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Arizona in 1941, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	471	800, 804	130, 298	213, 360	322, 564	4, 482, 513	
Dry and siliceous gold-silver ore	68	138, 611	13, 187	526, 518	542, 414	457, 950	
Dry and siliceous silver ore	72	36, 375	713	455, 936	192, 522	49, 792	
	[1] 594	975, 790	144, 198	1, 195, 814	1, 057, 500	4, 990, 255	
Copper ore	144	24, 153, 483	142, 498	5, 006, 374	[2] 647, 420, 204	261, 278	
Lead ore	98	18, 432	2, 129	130, 985	142, 351	4, 378, 355	
Lead-copper ore	5	663	19	3, 745	22, 668	62, 280	
Zinc ore	2	2, 143	58	13, 168	13, 270	17, 700	235, 200
Zinc-copper ore	1	80, 810	1, 069	224, 400	2, 533, 700	355, 000	8, 278, 000
Zinc-lead ore	10	260, 473	13, 490	921, 569	1, 444, 307	21, 211, 132	24, 472, 800
Total, lode mines	[1] 805	25, 491, 794	303, 461	7, 496, 055	[2] 652, 634, 000	31, 276, 000	32, 986, 000
Total, placers	184		11, 931	2, 205			
	989	25, 491, 794	315, 392	7, 498, 260	[2] 652, 634, 000	31, 276, 000	32, 986, 000
Total, 1940	1, 300	21, 572, 175	294, 807	7, 075, 215	[3] 562, 338, 000	26, 532, 000	30, 912, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 118,450,902 pounds recovered from ore leached and mine-water precipitates.
[3] Includes 103,327,137 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

Of the 25,491,794 tons of ore produced in 1941 in Arizona, 19,001,720 tons (75 percent) were treated at concentration plants, 3,785,654 tons (15 percent) were treated at a leaching plant, 833,910 tons (3 percent) were treated at amalgamation and cyanidation mills, and 1,870,510 tons (7 percent) were shipped crude to smelters.

Gold ore treated at amalgamation mills increased from 4,162 tons in 1940 to 7,517 tons in 1941 and siliceous material treated at cyanidation plants from 742,801 to 826,393 tons. Cyanidation plants were operated continuously in 1941 at the Goldroad, Gold Standard, Producers Mines, Inc., Congress, Octave, Mammoth-St. Anthony Limited, Alvarado, Yarnell, Vulture, Vivian, and Iron King properties. Nine companies reported cyaniding 667,990 tons of siliceous material and using 132,570 pounds of sodium cyanide, 1,142,000 pounds of Aero Brand calcium cyanide, 80,775 pounds of zinc dust, 2,776,950 pounds of lime, 1,175 pounds of aerosol, 200 pounds of lead acetate, and 165 pounds of lead nitrate.

Ore treated at concentration plants in 1941 comprised 6,940 tons of gold ore, 36,440 tons of gold-silver ore, 2,100 tons of silver ore, 18,607,089 tons of copper ore, 5,950 tons of lead ore, 600 tons of lead-copper ore, 2,143 tons of zinc ore, 80,810 tons of zinc-copper ore, and 259,648 tons of zinc-lead ore. Copper ore from the Miami property (5,821,077 tons) was treated by a combination of leaching and concentration and copper ore from the Inspiration mine was treated by straight leaching, but 298,706 tons of slimes discarded from the leaching-plant feed were concentrated. Large copper-concentration plants were operated continuously in 1941 at Ajo, Clarkdale, Hayden, Miami, Morenci, and Superior; copper-leaching plants at Inspiration and

Miami; and copper smelters at Clarkdale, Douglas, Hayden, Miami, and Superior. The 20-ton smelter at Tiger is the only lead smelter in Arizona, and it operated exclusively on concentrates from the mill of Mammoth-St. Anthony, Ltd.

The following tables give details of the treatment of all ores produced in Arizona in 1941.

Mine production of metals in Arizona in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	7,517	888	297			
Ore and old tailings cyanided	826,393	77,627	182,503			
Concentrates smelted	1,028,852	114,974	2,782,173	378,843,659	26,981,425	32,693,800
Ore smelted	1,870,510	109,972	4,531,082	155,339,439	4,294,575	292,200
Copper precipitates smelted	21,373			[1] 34,323,752		
Copper ore leached	[2] 3,785,654			84,127,150		
Placer		11,931	2,205			
		315,392	7,498,260	652,634,000	31,276,000	32,986,000
Total, 1940		294,807	7,075,215	562,338,000	26,532,000	30,912,000

[1] Distributed as follows: Cochise County, 821,616 pounds; Gila County, 6,086,086 pounds; Greenlee County, 12,485,800 pounds; Pinal County, 13,800,000 pounds, and Yavapai County, 1,130,250 pounds.
[2] Treated by straight leaching at 1 plant in Gila County.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Arizona in 1941, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Cochise	280	44	49	22	29	28		
Gila	33	8	4					
Maricopa	340	35	9	8	11	2		
Mohave	3,729	260	100	16	110	3		
Pima	182	29	12	2	7	6		
Pinal	35	11	3					
Santa Cruz	152	12	8	1	3	25		
Yavapai	2,608	452	103	24	160	81	1,200	1,505
Yuma	158	37	9					
	7,517	888	297	73	320	145	1,200	1,505
Total, 1940	4,162	882	321	45	103	232		2,236

CYANIDATION MILLS

County	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Cochise	400	7	219					
Maricopa	64,105	2,821	3,211	234	799	300	970	
Mohave	293,502	50,230	93,432					
Pima	7,720	1,573	7,519					
Pinal	193,577	4,099	8,351	5,112	27,840	30,000	7,086	4,344,800
Yavapai	267,054	18,866	69,767	632	8,806	11,556	26,800	110,770
Yuma	35	31	4					
	826,393	77,627	182,503	5,978	37,445	41,856	34,856	4,455,570
Total, 1940	742,801	72,141	125,009	5,269	34,011	39,260	16,144	3,904,600
Grand total: 1941		78,515	182,800	6,051	37,765	42,001	36,056	4,457,075
1940		73,023	125,330	5,314	34,114	39,492	16,144	3,906,836

Mine production of metals from concentrating mills in Arizona in 1941, by counties, in terms of recovered metals

County	Material treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	20, 115	7, 524	380	84, 320	434, 914	1, 651, 120	4, 189, 000
Gila	6, 120, 063	124, 075	1, 884	71, 688	74, 146, 889	44, 600	38, 800
Graham	2, 650	530	15	12, 530	43, 713	315, 287	-----
Greenlee	908, 152	37, 390	896	42, 000	15, 265, 000	-----	-----
Maricopa	5. 840	524	1, 038	12, 321	55, 071	-----	-----
Mohave	51, 193	12, 081	3, 534	137, 519	179, 212	4, 563, 005	4, 692, 000
Pima	7, 710, 867	224, 791	40, 435	443, 043	133, 017, 070	-----	-----
Pinal	3, 209, 701	270, 685	7, 858	554, 458	96, 332, 253	393, 229	8, 278, 000
Santa Cruz	93, 869	21, 523	154	449. 712	765, 325	12, 410, 965	10, 637, 000
Yavapai	875, 970	323, 186	21, 006	904, 795	58, 567, 656	2, 831, 144	4, 859, 000
Yuma	3, 300	492	9	27, 786	500	315, 000	-----
	19, 001, 720	1, 022, 801	77, 209	2, 740, 172	378, 807, 603	22, 524, 350	32, 693, 800
Total, 1940	15, 941, 271	856, 846	67. 337	2, 619, 155	318, 533, 602	20, 208, 281	30, 874, 492

Gross metal content of concentrates produced from ores mined in Arizona in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	651	2, 731	3, 727	4, 049	7, 875	-----
Dry gold-silver	38	23	1, 326	826	194	-----
Copper	953, 841	58, 799	1, 624, 764	390, 930, 948	52, 966	2, 919, 550
Lead	37, 666	52, 222	877, 915	882, 371	26, 521, 582	3, 617, 510
Lead-copper	2, 027	102	137, 078	262, 279	1, 803, 422	206, 200
Zinc	34, 629	1, 097	137, 363	734, 206	1, 125, 782	36, 575, 687
	1, 028, 852	114, 974	2, 782, 173	392, 814, 679	29, 511, 821	43, 318, 947
Total, 1940	862, 160	101, 451	2, 658, 647	329, 934, 421	26, 583, 580	41, 522, 522

Mine production of metals from Arizona concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	7,546	409	84,348	434,914	1,651,120	4,189,000
Gila	124,075	1,884	71,688	74,146,889	44,600	38,800
Graham	530	15	12,530	43,713	315,287	
Greenlee	37,390	896	42,000	15,265,000		
Maricopa	766	1,848	12,623	56,041		
Mohave	12,097	3,644	137,522	179,212	4,563,005	4,692,000
Pima	224,793	40,442	443,049	133,017,070		
Pinal	275,797	35,698	584,458	96,339,339	4,738,029	8,278,000
Santa Cruz	21,524	157	449,737	765,325	12,410,965	10,637,000
Yavapai	323,842	29,972	916,432	58,595,656	2,943,419	4,859,000
Yuma	492	9	27,786	500	315,000	
	1,028,852	114,974	2,782,173	378,843,659	26,981,425	32,693,800
Total, 1940	862,160	101,451	2,658,647	318,549,746	24,115,117	30,874,492

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	651	2,731	3,727	3,340	6,905	
Dry gold-silver	38	23	1,326	783	185	
Copper	953,841	58,799	1,624,764	377,327,938	31,780	
Lead	37,666	52,222	877,915	704,713	24,595,034	
Lead-copper	2,027	102	137,078	220,146	1,661,086	
Zinc	34,629	1,097	137,363	586,739	686,435	32,693,800
	1,028,852	114,974	2,782,173	378,843,659	26,981,425	32,693,800

Gross metal content of Arizona crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	26,266	14,432	73,346	298,817	31,936	
Dry and siliceous gold-silver	37,751	7,527	350,711	376,405	112,307	
Dry and siliceous silver	32,383	614	422,809	143,326	43,609	
Copper	1,760,740	85,290	3,592,043	165,648,895	472,257	
Lead	12,482	2,105	90,669	123,283	4,075,972	
Lead-copper	63	4	1,504	4,981	26,311	
Zinc-lead	825			831	198,355	343,601
	1,870,510	109,972	4,531,082	166,596,538	4,960,747	343,601
Total, 1940	1,685,544	114,092	4,290,130	150,143,477	2,660,351	42,135

Mine production of metals from Arizona crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	1,196,562	62,975	2,679,000	112,089,470	1,883,880	91,000
Coconino	1,060	7	502	139,000		
Gila	52,915	813	39,901	2,092,875	1,297,400	46,800
Graham	36	1	198	787	18,713	
Greenlee	10,625	741	119,415	11,200	90,000	154,400
Maricopa	6,184	1,166	30,185	55,959	118,300	
Mohave	4,500	1,910	54,800	42,288	287,995	
Pima	1,350	190	10,473	123,930	65,000	
Pinal	98,801	4,751	354,362	12,984,661	52,671	
Santa Cruz	3,586	540	60,915	51,675	205,035	
Yavapai	492,064	35,644	1,157,529	27,676,094	272,581	
Yuma	2,827	1,234	23,802	71,500	3,000	
	1,870,510	109,972	4,531,082	155,339,439	4,294,575	292,200
Total, 1940	1,685,544	114,092	4,290,130	140,461,117	2,416,883	37,508

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	26,266	14,432	73,346	285,338	20,038	
Dry and siliceous gold-silver	37,751	7,527	350,711	353,677	67,145	
Dry and siliceous silver	32,383	614	422,809	137,451	28,677	
Copper	1,760,740	85,290	3,592,043	154,459,920	261,278	
Lead	12,482	2,105	90,669	98,138	3,748,068	
Lead-copper	63	4	1,504	4,115	24,051	
Zinc-lead	825			800	145,318	292,200
	1,870,510	109,972	4,531,082	155,339,439	4,294,575	292,200

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cochise County:													
California	2		240	1		1	1,672		1,672	800	80,200		$5,889
Cochise	1		891	1		1	938		938	116,000			14,390
Dos Cabezas and Tevis	6		1,072	291		291	748		748	8,900	1,800		11,870
Golden Rule (Dragoon)	1		3				38		38		400		50
Hartford (Huachuca Mountains)	2	1	347	15	5	20	3,105		3,105	300	177,600		13,066
Kimball (Peloncillo)	2		4				14		14	800			104
Swisshelm	5		3,053	489		489	13,562		13,562	3,200	792,200		72,292
Tombstone	6		4,875	812		812	64,350		64,350	26,500	330,700		96,157
Turquoise	4		1,354	100		100	7,920		7,920	5,200	211,800	91,000	28,644
Warren	5	1	1,205,517	61,726	1	61,727	2,671,238		2,671,238	113,184,100	1,940,300	4,189,000	17,840,488
Winchester	1		1				31		31	200			46
Coconino County:													
Francis	1		73				24		24	3,500			430
Jacob Canyon and Warm Springs	3		987	7		7	478		478	135,500			16,574
Gila County:													
Banner and Dripping Springs	8	1	40,002	643	2	645	24,383		24,383	1,609,500	1,193,000	38,800	300,746
Globe-Miami	21	4	9,918,381	1,991	6	1,997	83,534		83,534	164,837,300	142,400	46,800	19,591,725
Green Valley	11	1	104	47	3	50	24		24				1,767
Pioneer (Pinal Mountains)	5		154	23		23	3,600		3,600	3,200	6,200		4,096
Spring Creek	1		2	1		1	38		38		400		85
Summit	2		22				14		14	3,000			364
Graham County:													
Aravaipa	3		2,680	16		16	12,721		12,721	44,000	334,000		33,836
Lone Star	2		6				7		7	500			64
Greenlee County:													
Ash Peak	2		9,533	392		392	116,242		116,242	1,500			96,558
Copper Mountain (Morenci)	6		908,691	1,187		1,187	44,903		44,903	27,757,800	4,000		3,349,124
Mayflower	1		23				114		114	2,700			400
Metcalf (Greenlee)	3		530	58		58	156		156		86,000	154,400	18,623
San Francisco		1			9	9							315
Maricopa County:													
Big Horn	2	2	79	68	10	78	31		31				2,752
Cave Creek and Camp Creek	6	1	1,872	152	1	153	12,216		12,216	68,800			22,160
Eagle Tail	1		1	2		2							70
Ellsworth (Harqua Hala) [1]	4		132	22		22	45		45	7,100			1,640
Gila Bend Mountains	2		114	8		8	7		7				285
New River	1		5				14		14	2,700			329
Osborn	2		546	100		100	1,727		1,727	8,900	117,400		12,470

Pikes Peak (Morgan City)	10	1	285	136	1	137	135		135	1,800			5,103
Salt River Mountains	1		4,141	1,019		1,019	841		841				36,263
San Domingo	2	2	21	39	15	54	14	7	21				1,905
Sunflower	1		361	86		86	135		135	200			3,130
Vulture	13	2	64,733	3,789	3	3,792	30,240		30,240	22,500	900		156,930
White Butte	1		10	7		7	7		7				250
Wickenburg	1	1	3,700	264	2	266	554		554				9,704
Winifred	2		469	178		178	62		62				6,274
Mohave County:													
Cedar Valley	3		177	15		15	4,507		4,507	63,300	100		11,205
Chemehuevis	3	2	42	13	14	27	14		14		200		966
Cottonwood	3		241	68		68	377		377	9,000	2,000		3,824
Gold Basin	13	2	1,168	584	99	683	367	14	381	1,400	19,400		25,447
Greenwood	4		8	4		4	121		121		100		232
Indian Secret (White Hills)	5		1,246	181		181	5,227		5,227				10,052
Lost Basin		3			46	46		7	7				1,615
Maynard and McConnico	3		3,580	291		291	2,804		2,804				12,179
Minnesota	9		3,698	696		696	5,438		5,438		300		28,244
Music Mountain	6		338	270		270	1,080		1,080	300	2,000		10,367
Owens	18		703	119		119	5,708		5,708	12,700	10,700		10,333
Peacock	1		9	2		2							70
San Francisco (Oatman, Goldroad, Katherine, Vivian)	36		252,458	42,098		42,098	43,823		43,823	2,100			1,504,841
Wallapai	71		70,398	7,500		7,500	213,577		213,577	132,700	4,816,200	4,692,000	1,056,459
Weaver	18		18,858	4,203		4,203	2,811		2,811				149,104
Pima County:													
Ajo	1		7,681,667	40,405		40,405	423,000		423,000	131,760,000			17,262,655
Amole	3		86	16		16	204		204	800	18,800		1,871
Arivaca	13	3	148	85	4	89	1,087		1,087	700	800		4,017
Baboquivari	4		7,730	1,586		1,586	7,664		7,664				60,960
Cababi (Comobabi)	11		314	83		83	938		938	4,150	3,000		4,233
Cerro Colorado	1		1				481		481	50	200		359
Empire	3		7				76		76	100	2,300		197
Greaterville	1	1	7		7	7	28		28				265
Helvetia (Rosemont)	8		440	13		13	1,966		1,966	58,300	8,300		9,205
Meyer	1		3	3		3							105
Old Hat [2]	2		29,329	36		36	20,423		20,423	1,289,900			167,991
Pima (Sierritas, Papago, Twin Buttes)	5	1	93	3	2	5	2,541		2,541	2,300	7,300		2,669
Quijotoa		1			5	5							175
Roskruge and Waterman	1		196	1		1	1,357		1,357	23,200	5,000		4,023
Silver Bell	2		98	3		3	1,288		1,288	1,500	19,300		2,298
Pinal County:													
Bunker Hill	1		624	17		17	2,551		2,551	21 000	51,200		7,805
Casa Grande	6		2,517	38		38	47,499		47,499	20,900	400		37,596
Cottonwood and Black Mountain	4		114	53		53	45		45	1,000			2,005
Goldfields	3		902	116		116	623		623	7,200			5,353
Hackberry	1		3	2		2	7		7				75
Mineral Creek	2		2,882,412	851		851	58,618		58,618	84,800,000			10,077,869
Mineral Hill	14		1,157	400		400	1,028		1,028	18,200	38,000		19,045
Old Hat [2]	9	2	193,130	31,940	3	31,943	38,323		38,323	13,300	4,344,800		1,394,480
Owl Head	1		77	1		1	952		952				712

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing: Lode	Mines producing: Placer	Ore sold or treated (short tons)	Gold (fine ounces): Lode	Gold: Placer	Gold: Total	Silver (fine ounces): Lode	Silver: Placer	Silver: Total	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
Pinal County—Continued.													
Pioneer (Superior)	9		420,635	10,987		10,987	794,406		794,406	38,238,400	355,000	8,278,000	$6,102,672
Ripsey	1		502	150		150	3,001		3,001				7,384
Rodgers	1		2	1		1	7		7		1,300		114
Saddle Mountain	2		39	3		3	114		114	4,000			658
Santa Cruz County:													
Harshaw	6		68,652	125		125	367,027		367,027	213,900	11,082,400	7,032,000	1,451,959
Nogales (Gold Hill)	5		184	19		19	239		239	3,300	200		1,235
Oro Blanco	18		1,411	483		483	13,770		13,770	1,700	2,200		27,023
Pajarito	1		2				69		69		100		55
Palmetto	2		176				208		208	9,400	2,900		1,422
Patagonia	9		26,720	67		67	124,456		124,456	579,600	1,409,000	3,575,000	507,678
Redrock	1		3				31		31	100			34
Tyndall	4		438	13		13	3,271		3,271	8,800	118,800		10,591
Wrightson	3		21	2		2	1,589		1,589	200	400		1,247
Yavapai County:													
Agua Fria	1		40	3		3	14		14	6,600			894
Ash Creek	1		145	69		69	391		391	1,000			2,811
Big Bug	14	14	138,642	9,612	6,056	15,668	324,938	533	325,471	187,400	1,188,700	3,607,000	1,140,220
Black Canyon	8	4	28,171	3,326	11	3,337	88,851		88,851	10,800	420,000		205,192
Black Hills	3		73	27		27	114		114	1,600			1,215
Black Rock	16	2	537	179	20	199	135	7	142	10,700	2,900		8,494
Blue Tank	4	1	25	20	1	21	21		21	1,700			951
Bullard (Pierce)	4		2,190	887		887	533		533	103,100			43,590
Castle Creek	8	2	352	40	5	45	1,243		1,243	2,000	154,700		11,513
Cherry Creek	17		598	452		452	436		436	1,200			16,272
Copper Basin	2	9	2	3	46	49		7	7				1,720
Eureka	18		120,119	5,440		5,440	69,404		69,404	2,288,800	1,294,100	1,252,000	677,496
Granite Creek		3			7	7							245
Hassayampa	38	8	1,718	1,186	105	1,291	5,213	21	5,234	3,000	11,100		49,894
Humbug	2	5	154	58	30	88	128	7	135				3,176
Kirkland	2		61	50		50	7		7				1,755
Lynx Creek		14			4,372	4,372		886	886				153,650
Martinez	5		99,912	6,826		6,826	15,075		15,075				249,630
Mineral Point	1		2	2		2							70
Peck	1		223	2		2	8,927		8,927		600		6,452
Pine Grove	9		5,247	3,000		3,000	29,475		29,475	44,500	19,400		132,317
Silver Mountain	4		183	12		12	5,670		5,670		1,000		4,509
Squaw Creek	1		8	22		22	7		7				775
Tiger	7		284	383		383	661		661	1,100			14,005
Tip Top		1			2	2							70

Turkey Creek	4	2	33	24	5	29	59		59	100	200		1,080
Verde	6		1,121,004	32,047		32,047	1,544,317		1,544,317	84,484,800			12,189,032
Wagoner		4			7	7							245
Walker	22	10	8,360	1,060	56	1,116	24,172	14	24,186	176,300	4,600		77,324
Walnut Grove	6	3	107	32	6	38	121		121	9,400	400		2,548
Weaver	22	26	108,715	20,065	125	20,190	19,824	10	19,834	28,600	115,600		730,718
White Picacho	11		791	107		107	4,095		4,095	39,300	2,700		11,448
Yuma County:													
Castle Dome	2	1	43	36	467	503	467	661	1,128		2,700		18,561
Cienega	4		392	132		132	45		45	17,700			6,741
Dome (Gila City)		1			11	11							385
Ellsworth (Harqua Hala) [1]	33		659	300		300	675		675	26,600			14,119
Eureka	1		3,300	9		9	27,786		27,786	500	315,000		38,088
Fortuna	1	2	8	1	4	5							175
Kofa	4	1	44	123	5	128	166		166				4,598
Laguna		1			9	9							315
La Paz and Middle Camp	2	11	15	41	133	174	606	14	620	9,800			7,687
Mohawk	1		33				294		294	600			280
Plomosa and La Cholla	14	20	1,771	666	186	852	21,510	17	21,527	8,000	300		46,089
Santa Maria (Planet, Bill Williams)	1		55	3		3	52		52	8,800			1,180
Trigo		6			24	24							840
Total Arizona	805	184	25,491.794	303,461	11,931	315,392	7,496,055	2,205	7,498,260	652,634,000	31,276,000	32,986,000	97,638,310

[1] Ellsworth district lies in both Maricopa and Yuma Counties.
[2] Old Hat district lies in both Pima and Pinal Counties.

COCHISE COUNTY

California district (Hilltop).—Lessees operated the Columbia and Hilltop mines in 1941 and shipped silver-lead ore to the smelter at El Paso, Tex.

Cochise district.—Approximately 900 tons of copper ore were produced in 1941 from the old Republic mine near Dragoon.

Dos Cabezas and Tevis district.—The Dives property, operated by the Santa Maria Mining Corporation, was the chief producer in the Dos Cabezas and Tevis district in 1941; about 700 tons of crude gold ore were shipped to a smelter. Other producers of gold ore included the Gold Prince and Gold Spot properties.

Hartford (Huachuca Mountains) district.—Nearly all the output in the Hartford district in 1941 was silver-lead ore from the Armistice group near Hereford.

Kimball (Peloncillo) district.—Small lots of copper ore were produced in 1941 from the Quien Sabe and Willie Rose claims near San Simon.

Swisshelm district (Elfrida).—The metal output of the Swisshelm district was much greater in 1941 than in 1940, owing to the marked increase in shipments of silver-lead ore from the Scribner mine; lessees shipped about 3,000 tons of ore to El Paso, Tex. Silver-lead ore was produced also from the Chance, Juan Lares, and No Name No. 1 properties.

Tombstone district.—Gold-silver ore and silver-lead ore from the Tombstone Development property continued in 1941 to be the most important output in the Tombstone district; however, production declined to 4,180 tons in 1941. The remainder of the district output was mainly silver-lead ore from the Tombstone Extension mine and silver ore from the Manganese Silver and South Bonanza properties.

Turquoise district (Courtland, Pearce, Gleeson).—About 700 tons of lead ore and 200 tons of zinc-lead ore were produced in 1941 from the Defiance mine and 333 tons of gold-silver ore from the Commonwealth mine. The rest of the district output was chiefly lead ore from the No Account group.

Warren district (Bisbee, Warren).—The value of the metal output of the Warren district in 1941 increased nearly 7 percent over 1940. Crude copper ore (1,080,969 tons) from the Copper Queen branch of the Phelps Dodge Corporation was again the principal output; the property remained the largest producer of gold and silver in the State and ranked second in copper.

The Bisbee mines of the Copper Queen branch of the Phelps Dodge Corporation produced 836,248 tons of ore from the Limestone area, according to the annual report of the corporation for 1941. Operations were conducted virtually at capacity throughout the year; shipments of siliceous flux to the Douglas smelter from the Southeast Extension porphyry ore body totaled 214,075 tons; lease operations produced 30,646 tons of copper ore; and shipments of copper precipitates from surface and underground plants aggregated 807 tons. The advance in exploration, development, and stope preparation totaled 65,238 feet; in addition, 15,824 feet of diamond drilling were done. The total footage driven for exploration and development was less than in 1940, but satisfactory results were obtained in maintaining ore reserves. At the end of August a very heavy flow of water, which flooded the mine up to the 2,433 level, was encountered east of the Campbell fault on the 2,700 level. Large sinking pumps were in-

stalled, and by the end of the year the mine had been unwatered with the exception of an area east of the Campbell fault. The flood did not interfere seriously with ore production but did retard development.

The flood extended into the Denn mine of the Shattuck Denn Mining Corporation and caused suspension of copper-ore production during September; in consequence, the output of copper ore decreased from 124,811 tons in 1940 to 102,828 tons in 1941; however, the output of zinc-lead ore from the mine increased to 20,115 tons. The remainder of the district production was mostly copper ore from the Shattuck mine and rich gold ore from the Sure Thing claim.

COCONINO COUNTY

Francis district.—The output of the Francis district in 1941 was copper ore from the Emerald & Ruby property.

Jacob Canyon and Warm Springs district.—A total of 987 tons of carbonate copper ore was produced in 1941 from the Brown Derby, Mackin, and Petoskey properties; the Mackin mine was by far the largest producer.

GILA COUNTY

Banner and Dripping Springs district.—The Sam Knight Lease operated the Christmas mine continuously in 1941 and shipped 35,791 tons of copper ore to a smelter—a substantial increase over 1940. Lead ore (2,979 tons) and zinc-lead ore (280 tons) were produced from the "79" mine and gold ore from the Apex, Columbia, Gold Queen, Round Top, and Standard properties. The rest of the district output was mainly copper ore from the Round Top and Chilito mines.

Globe-Miami district.—The Globe-Miami district, with a production of 164,837,300 net pounds of copper in 1941, remained the chief copper-producing area in Arizona; the output increased 17 percent over that in 1940. The Inspiration property, with a yield of 91,841,640 net pounds of copper, was the largest producer of copper in the district and ranked third in the State. According to the printed annual report of the Inspiration Consolidated Copper Co. for 1941, 3,843,931 tons of copper ore from which the slimes had been removed were treated by ferric sulfate leaching. The ore averaged 1.23 percent copper, of which 0.659 percent was oxide and 0.571 percent sulfide; extraction was 98.483 percent of the oxide and 80.21 percent of the sulfide. The slimes (298,706 tons) removed from the ore were treated at the concentrator to recover the sulfide copper, and the tailings were treated with sulfuric acid to dissolve the oxide copper. Leaching operations were at the highest rate since operations began in 1926. A monthly production of 8,000,000 pounds of net copper was attained in August and maintained throughout the remainder of the year. The company has contracted for the building and equipping of a new acid plant and has started the necessary alterations and new installations in the concentrator to increase the production of copper by about 2,000,000 pounds a month. The Miami Copper Co. operated its 18,000-ton concentrator and 3,000-ton leaching plant continuously and treated 5,821,077 tons of copper ore, an increase of 10 percent over 1940. According to the printed annual report of the company, it is estimated that the mining of the mixed ore body will be completed about September 1942. After this date the tonnage will be replaced by a somewhat larger tonnage of sulfide ore, which will tend to reduce copper production, as the sulfide ore yields less copper per ton than does

the mixed ore. To increase copper production beyond the existing capacity of the property, facilities were installed during the year for leaching and precipitating copper from the broken ore and capping that remaining in abandoned parts of the mine; copper production from this source was begun in January 1942. The rest of the district output was largely crude silver ore and zinc-lead ore from the Old Dominion property and crude copper ore from the Carlota mine.

Green Valley district (Payson).—Virtually all the metal output of the Green Valley district in 1941 was gold ore, mainly from the Planet, Golden Hill, and Payrock properties.

Pioneer (Pinal Mountains) district.—About 154 tons of ore were produced in the Pioneer district in 1941; most of it was silver ore from the Pioneer mine, copper ore from the Bob Tail group, and lead ore from the Penial claim.

Summit district.—A little copper ore was produced in 1941 from the Ritchard and Yan properties near Miami.

GRAHAM COUNTY

Nearly all the output of Graham County in 1941 was old tailings, containing chiefly silver, lead, and copper, from the Grand Reef property in the Aravaipa district.

GREENLEE COUNTY

Ash Peak district (Duncan).—Lessees operated the Ash Peak and Hardy mines in 1941 and shipped a total of 9,533 tons of silver ore; the Ash Peak property was the largest producer.

Copper Mountain district (Morenci).—The metal output of the Copper Mountain district continued in 1941 to be principally copper ore and copper precipitates from the Morenci branch of the Phelps Dodge Corporation. The corporation treated 908,152 tons of copper ore in its testing concentrator and shipped 8,116 tons of copper precipitates. The remainder of the district output was mostly crude gold ore from the Gold Belt and Bianes & Pitts properties and gold-silver ore from the Emma Gomez claim.

According to the annual report of the Phelps Dodge Corporation for 1941, stripping operations at the Morenci branch removed 20,266,896 tons of material from the open pit; by the end of 1941, 49,183,602 tons of material in all had been removed from the pit, exclusive of ore mined for the test concentrator. As the year closed, stripping operations planned in advance of actual mining had been completed and the pit developed to permit a daily ore extraction of 25,000 tons. Railroad construction was pushed, and by December 31 about 60 percent of the main haulageway had been brought to its permanent position and the remaining 40 percent put in good operating condition. In the test-pit area a total of 1,002,315 tons of material comprising 943,493 tons of ore and 58,822 tons of waste was mined. Major construction projects completed in 1941, aside from the new reduction works, included 14 new dwellings, a 10,000,000-gallon reservoir to serve the new concentrator, installation of a new water-pipe line, and the building of a mine A. C.-D. C. substation. Virtually all essential buildings and shops at the reduction works were completed and occupied; the concentrator was about 90 percent finished, one unit of the power plant was nearly ready to run, and the smelting and converting plants were about 75 percent complete.

Mayflower district.—A little copper ore was produced in 1941 from the Providencia mine.

Metcalf (Greenlee) district.—The output of the Metcalf district in 1941 comprised 446 tons of crude zinc-lead ore from the Lime Cap mine, 61 tons of gold ore from the South Sycamore mine, and 23 tons of lead ore from the Midnight claim.

San Francisco district.—The American Gold placer property was worked a short time in 1941, and a little gold was recovered.

MARICOPA COUNTY

Big Horn district.—The principal production in the Big Horn district in 1941 was lode gold from the Big Horn mine and placer gold from the Davenport and Tiger properties.

Cave Creek and Camp Creek district.—The Red Rover mine on Camp Creek was operated the first 5 months of 1941, and about 1,500 tons of silver-copper ore were treated by flotation. The remainder of the district output was mainly gold ore from the Black Mountain, Edwards, and Defense properties.

Ellsworth (Harqua Hala) district.—Nearly all the output of the Ellsworth district in 1941 was copper ore from the Sonny and Columbia properties.

Gila Bend Mountains district.—Gold ore was produced in 1941 from the Blue Ribbon and Sunset properties near Gila Bend.

New River district.—A small lot of copper ore was produced in 1941 from the Daisy claim.

Osborn district.—Crude lead ore (545 tons) from the Belmont-McNeil mine was virtually the only output in the Osborn district in 1941; the mine was operated throughout the year by various lessees.

Pikes Peak (Morgan City) district.—There were 10 producers of gold ore in the Pikes Peak district in 1941, but most of the output came from the Pikes Peak group.

Salt River Mountains district.—The Delta mine, the only producer in the Salt River Mountains district in 1941, was operated continuously by the Park View Mining Co.; about 4,000 tons of gold ore were treated by flotation, and 141 tons of similar ore were shipped to a smelter.

San Domingo district.—Lessees operated the Gold Queen Standard property in 1941 and produced 20 tons of rich gold ore. The remainder of the district output was principally placer gold recovered by various operators working along San Domingo Wash.

Sunflower district.—Mining and milling were continued in 1941 at the Little Daisy mine; most of the output was gold ore treated by flotation.

Vulture district.—The chief output of the Vulture district in 1941, as in 1940, was gold ore from the Vulture mine. The East Vulture Mining Co. operated the mine continuously and treated 52,085 tons of gold ore and 8,140 tons of old tailings by cyanidation and concentration; it was by far the largest producer of gold in Maricopa County. The rest of the district output was largely crude gold-silver ore (4,295 tons) from the Newsboy (Pitt) mine.

White Butte district.—A little gold ore was produced in 1941 from the Charlotte claim near Phoenix.

Wickenburg district.—In 1941 about 3,700 tons of old tailings (gold) from a dump near Wickenburg were treated by cyanidation.

Winifred district.—All the output of the Winifred district in 1941 was gold ore, principally from the Jack White mine near Phoenix.

MOHAVE COUNTY

Cedar Valley district.—Complex ore from the Boriana mine continued in 1941 to be the principal output in the Cedar Valley district; 10,077 tons of ore were treated in a 120-ton concentration mill. Copper concentrates were shipped from the mill to a smelter in Arizona. Gold-silver ore and silver ore were produced at the Bunker Hill mine.

Chemehuevis district.—Small lots of gold ore were produced in 1941 from the Copper Ledge, Dutch Flat, and Gold Dome properties; placer gold was recovered from the Chief claim and "49" Diggings.

Cottonwood district.—About 200 tons of copper ore were shipped from the Copper Giant mine in 1941, and a little gold ore was produced from the Gold Mountain and North Star properties.

Gold Basin district.—There was a marked decline in output of gold in the Gold Basin district in 1941, owing to idleness of the cyanide mill at the Cyclopic mine and to closing of the concentration mill of the Malco Gold Mining Co. The chief production in 1941 was lode gold, mainly from the Golden Link, O. K., Excelsior, and M. O. properties, and placer gold from the Gold Basin Placers.

Indian Secret (White Hills) district.—More than 1,200 tons of ore were produced in the Indian Secret district in 1941; the output was all gold ore, silver ore, and gold-silver ore treated in a custom cyanide mill from various claims of the White Hills group.

Lost Basin district.—The entire output of the Lost Basin district in 1941 was placer gold and silver recovered by various operators working the Lost Basin Placers.

Maynard and McConnico district.—Production of gold in the Maynard and McConnico district increased in 1941, owing to mining and milling operations at the Bimetal mine by the W. H. M. Gold Mining Co. The gain in output of silver resulted from shipments of gold-silver ore from the Democrat mine.

Minnesota district.—About 3,700 tons of ore were produced in the Minnesota district in 1941, more than double that in 1940; 83 percent of the output was gold ore treated in a custom cyanide mill, from the Van Diemon, Yellow Aster, and Pope properties. The remainder was largely gold-silver ore from the Horn Silver mine.

Music Mountain district.—All the output of the Music Mountain district in 1941 was gold ore, principally from the Portland & Mizpah, Roosevelt, and Mohawk properties.

Owens (McCracken and Potts Mountain) district.—Numerous small lots of crude gold ore and copper-gold ore, produced from various claims in the Owens district in 1941, were sold to the Wickenburg Ore Market; however, the chief output was silver ore from the North Star mine, shipped to a smelter.

San Francisco (Oatman, Goldroad, Katherine, Vivian) district.—Production of gold in the San Francisco district was 42,098 fine ounces in 1941—a slight gain over 1940. The Goldroad mine of the United States Smelting, Refining & Mining Co. was by far the most important producer in the district; 154,436 tons of gold ore were treated in the company 300-ton cyanide plant in 1941 compared with 153,280 tons in 1940. The property again ranked fourth in gold production in the State.

Production of gold at Oatman, Goldroad, and Vivian in 1941 was 34,114 fine ounces compared with 32,044 in 1940, and that at Katherine was 7,984 ounces compared with 9,565; 94 percent of the gold output at Katherine came from the Tyro mine worked by the Gold Standard Mines Corporation. The company operated its 300-ton cyanide mill continuously, chiefly on gold ore (81,992 tons) from the Tyro mine. Other producers at Katherine included the Buellard, Burt, King of Secret Pass, Minnie, Philadelphia, and Sheep Trail properties. The chief producers of gold at Oatman and Vivian were the Vivian, Telluride, Western Apex, Pioneer, Gold Dust, and Sunnyside properties. The Vivian Mining Co. operated its 100-ton custom cyanide plant throughout the year, mainly on old tailings from the Vivian dump and on gold ore from the Vivian-Lelande Mitchell group; a total of 5,838 tons of old tailings and 4,377 tons of gold ore was treated.

Wallapai district (Cerbat, Chloride, Mineral Park, Stockton Hill).—Of the total ore (70,398 tons) produced in the Wallapai district in 1941, 64 percent was zinc-lead ore from the Tennessee mine operated by the Tennessee-Schuylkill Corporation. The company worked the mine continuously and treated 45,150 tons of zinc-lead ore in its 150-ton flotation mill—a decline of 10,371 tons from 1940; the mine ranked second in lead production in Arizona in 1941 and third in zinc. About 21 percent of the district output was gold ore, largely from the Tin Cup, Golden Gem, O'Brien, Golden Eagle, Rainbow, Red Seal, and Tintic properties. The remainder was chiefly gold-silver ore from the Nighthawk, C. O. D., Lucky Boy, Summit, Juno, and Mint properties; zinc ore from the Middle Golconda mine; silver ore from the Distaff and Silver Age mines; and lead ore from the Summit group. Concentration mills were operated at the C. O. D., Golden Gem, and Middle Golconda properties; and several thousand tons of gold ore, gold-silver ore, and silver ore were treated in the custom cyanide mill of Producers Mines, Inc.

Weaver (Mocking Bird, Pilgrim, Portland) district.—The output of ore and yield of gold and silver in the Weaver district in 1941 were much less than in 1940; the output of ore declined from 40,571 tons in 1940 to 18,858 tons in 1941, owing chiefly to the large decrease in output of gold ore from the Pilgrim mine of Producers Mines, Inc. The 300-ton cyanide mill owned by the company was operated almost exclusively on custom ores; a total of 46,540 tons of ore was milled in 1941 (2,322 tons of gold ore came from the Pilgrim mine). The most important producer in the district in 1941 was the Golden Door mine; 15,207 tons of gold ore were treated by cyanidation.

PIMA COUNTY

Ajo district.—Production of gold, silver, and copper in the Ajo district was much greater in 1941 than in 1940, owing to the large increase in output of copper ore from the New Cornelia mine, only producer in the district in 1941. The property remained the largest producer of copper in Arizona and ranked second in gold.

According to the annual report of the corporation for 1941, operations at the New Cornelia branch of the Phelps Dodge Corporation were at a maximum capacity (three-shift basis) throughout the year. Production at the open pit comprised 7,682,444 tons of copper ore and 7,232,688 tons of waste. The 22,500-ton concentrator treated 7,681,667 tons of copper ore with satisfactory metallurgy and with

improved unit efficiencies. The grinding capacity of the ball mills was increased, resulting in a greater output of copper concentrates.

Amole district.—Nearly all the output of the Amole district in 1941 was lead ore from the Old Yuma mine.

Arivaca district.—Various small-scale operators in the Arivaca district produced a total of 148 tons of ore in 1941; most of it was crude gold ore from the Oreona, Backbone, and Gold Plate properties.

Baboquivari district.—Operations at the Allison mine were greatly expanded in 1941, resulting in an increased output of gold ore. The property was operated continuously by the Gold Bar Mining Co. (formerly Tombstone Mining Co.) and 7,720 tons of gold ore were treated by cyanidation. The rest of the district output was small lots of crude gold ore from various prospects.

Cababi (Comobabi) district.—There were 11 producers in the Cababi district in 1941, but the chief output was gold ore from the Jaeger, Grand Central, Sophia, and Wayne properties.

Cerro Colorado district.—A small lot of silver-lead-copper ore was produced in 1941 from the Mary "G" claim.

Empire district.—Small lots of lead ore were produced in 1941 from the Esperanza, Chief, and Virgin properties.

Greaterville district.—The principal output of the Greaterville district in 1941 was placer gold recovered from the Greaterville Placers.

Helvetia (Rosemont) district.—About 420 tons of copper ore and a little lead ore were produced in the Helvetia district in 1941; the chief producer was the Copper World (Leader) mine.

Old Hat district (Oracle).—Continuous mining and milling operations throughout 1941 at the Daily and Geeseman groups by Control Mines, Inc., resulted in a greater output of silver and copper in the Old Hat district in Pima County. The company treated 29,200 tons of copper ore by flotation in 1941 compared with 24,000 tons in 1940. A little copper ore was produced also from the Apache mine.

Pima (Sierritas, Papago, Twin Buttes) district.—The output of the Pima district in 1941 was largely silver ore from the Black Silver property near Sahuarita.

Roskruge and Waterman (Silver Hill) district.—A lessee operated the Silver Hill mine in 1941 and shipped silver-copper ore and silver-lead ore to various smelters.

Silver Bell district.—Nearly all the output of the Silver Bell district in 1941 was silver-lead ore from the Indiana mine.

PINAL COUNTY

Bunker Hill district (Copper Creek).—In 1941 the Bunker Hill mine, operated by the Ari-Butte Operating Co., was the only producer in the Bunker Hill district; the output was mainly lead-copper ore treated by flotation.

Casa Grande district.—Output of silver in the Casa Grande district showed a marked increase in 1941, owing to steady shipments throughout the year of silver ore from the Silver Reef mine; 2,335 tons of ore were shipped to the smelter at Superior The remainder of the district output was chiefly silver-copper ore from the Reward mine.

Cottonwood and Black Mountain district.—Nearly all the ore produced in the Cottonwood and Black Mountain district in 1941 was crude gold ore from the Grand Prize mine.

Goldfields (Superstition Mountains) district.—In 1941, as in 1940, the principal output of the Goldfields district was old tailings (gold) from the Bulldog dump and first-class gold ore from the Superstition mine.

Mineral Creek district (Ray).—Operations at the Ray mine of the Nevada Consolidated Copper Corporation were expanded in 1941, resulting in a marked increase in output of copper. The company reported that 2,882,406 tons of copper ore were treated in the company 12,000-ton concentrator in 1941 compared with 2,103,004 tons in 1940. In addition, 7,820 tons of copper precipitates were shipped to the smelter at Hayden; the property ranked fourth in copper production in Arizona in 1941. The district output of gold decreased considerably in 1941, owing to suspension of operations at the Broken Hill gold mine in June 1940.

Mineral Hill district.—Production in the Mineral Hill district in 1941 totaled 1,157 tons of ore—a decline of 41 percent from 1940. The principal output was crude gold ore from the Sunset, Wedge, Kitty Why, Troxel, and Consolidated Gold properties.

Old Hat district (Oracle).—Mining and milling operations at the Mammoth-St. Anthony & New Year-Mohawk groups were continuous throughout 1941; the output (192,977 tons) of ore was slightly greater than in 1940. The ore was treated by gravity concentration, followed by flotation, and the flotation tailings were treated by cyanidation. Lead concentrates containing considerable quantities of gold and other metals were smelted in the company 20-ton lead furnace, and gold precipitates were shipped to an eastern refinery. The property was the largest producer of gold from siliceous gold ore in Arizona in 1941 and ranked third in lead output. The remainder of the district output was largely crude gold ore from the Southern Belle mine.

Owl Head district.—The San Antonio No. 1 claim near Oracle was operated in 1941, and 77 tons of silver ore were shipped to a smelter.

Pioneer district (Superior).—Copper ore and zinc-copper ore from the Magma mine were, as usual, the chief output in the Pioneer district in 1941. The Magma Copper Co. operated its mine, 850-ton concentrator, and 450-ton copper smelter continuously, except for the usual summer shut-down. According to the company printed annual report, the mill treated 245,885 tons of copper ore averaging 5.26 percent copper and 80,810 tons of zinc-copper ore averaging 1.77 percent copper and 8.16 percent zinc; in addition, 78,177 tons of copper ore were sent direct to the smelter. Production, after all losses (including refining) were deducted, was 11,741 ounces of gold, 631,189 ounces of silver, 37,152,224 pounds of copper, and 7,715,313 pounds of zinc. The average net cost of producing copper after deduction of gold, silver, and zinc concentrate values was 7.9 cents a pound. Stoping operations were carried on at the usual rate until September 1, when production was speeded for defense purposes; an increase of about 15 percent was attained by October 1. The rest of the district output was largely crude silver ore (9,124 tons) from the Reymert mine and crude gold ore (4,765 tons) from the Lake Superior & Arizona property.

Ripsey district.—Gold-silver ore (502 tons) from the Norman group (Old Ripsey) was the only output in the Ripsey district in 1941.

Saddle Mountain district.—A little copper ore was produced in 1941 from the Senator mine and gold ore from the Columbia No. 1 claim.

SANTA CRUZ COUNTY

Harshaw district.—Zinc-lead-silver ore from the Trench and Flux groups was by far the principal output in the Harshaw district in 1941. The American Smelting & Refining Co. operated both groups and its 200-ton concentrator continuously; about 67,300 tons of ore were treated in 1941 compared with 49,311 tons in 1940. The company was again the largest producer of lead in Arizona and ranked second in zinc. The remainder of the district output was chiefly crude silver ore from the American, Salvador, and World's Fair properties.

Nogales (Gold Hill) district.—Nearly all the output of the Nogales district in 1941 was gold-silver ore from the Roy mine and gold ore from the Louella Lou, Hardscrabble, and Silent Friend properties.

Oro Blanco district (Ruby).—Production in the Oro Blanco district in 1941 was 1,411 tons of ore, a marked decline from 54,564 tons in 1940. This large loss resulted from suspension of operations at the Montana zinc-lead-silver property in May 1940. The district output in 1941 was largely gold-silver ore from the Old Soldier and Noon properties, silver ore from the Brick claim, and gold ore from the Oro Blanco mine.

Palmetto district.—In 1941 about 170 tons of copper ore from the Three R mine were concentrated, and a small lot of crude silver-lead ore from the La Palma claim was sold to a local ore buyer.

Patagonia (Duquesne) district.—The increased output of silver, copper, lead, and zinc in the Patagonia district in 1941 resulted from continuous mining and milling operations at the Duquesne property by the Callahan Zinc-Lead Co. The company reported that 27,572 wet tons of zinc-lead-copper ore were treated by flotation in 1941 and that 1,109 tons of silver-lead-copper concentrates and 696 tons of copper concentrates were shipped to El Paso, Tex., and 3,601 tons of zinc concentrates to Amarillo, Tex. The rest of the district output was mainly copper ore from the Gladstone, Paymaster, and Quajalote properties and lead ore from the Mowry mine.

Tyndall district.—Nearly all the output of the Tyndall district in 1941 was crude lead ore from the Jefferson mine and lead-silver ore and lead-copper ore from the Alto group.

Wrightson district.—A little silver ore was produced in 1941 from the Armada and Lucky Strike claims and a small lot of copper ore from the American Boy prospect.

YAVAPAI COUNTY

Agua Fria district.—The Burzog (Old Minor) property was operated in 1941, and 1 car of copper ore was shipped to a smelter.

Ash Creek district.—Lessees worked the Gold Coin mine in 1941 and produced 145 tons of first-class gold ore.

Big Bug district.—There was a marked increase in production of gold and silver and a gain in copper and zinc but a decline in lead in the Big Bug district in 1941. The principal output in 1941 was zinc-lead-gold-silver ore from the Iron King mine at Humboldt; 69,159 tons of zinc-lead ore were treated by flotation, 60,206 tons of current flotation tailings (gold-silver) were treated by cyanidation, and 6,419 tons of crude gold-silver ore were shipped to a smelter. The remainder of the district lode output was chiefly crude gold ore (1,956 tons) from the Postmaster mine. The output of placer gold was 6,056 fine

ounces—an increase of 4,652 ounces over 1940; the gain resulted from operation of a dragline floating dredge at the Star (Lawson) property by Arical Mines, Inc. The Big Bug Dredging Co. operated a dragline floating dredge at the Hill property until March 12, when it was moved to a property in the Lynx Creek district.

Black Canyon district.—The output of ore and yield of gold, silver, copper, and lead in the Black Canyon district were less in 1941 than in 1940, owing to the large decrease in output of gold-silver-lead ore from the Golden Turkey group near Cordes; the output dropped from 43,544 to 27,283 tons. The remainder of the district output was largely silver ore from the Silver Cord and Thunderbolt mines.

Black Hills district.—Gold ore was produced in 1941 from the Ambassador and D. & M. mines and copper ore from the Yeager claim.

Black Rock district.—The output of the Black Rock district in 1941 was principally gold ore from the Super X (Atos) mine, treated in a cyanide mill. Numerous small lots of crude gold ore and copper-gold ore were produced from various claims and sold to the Wickenburg Ore Market; placer gold was recovered chiefly from the Justin Placers.

Blue Tank district.—Small lots of gold ore were produced in 1941 from the Franklin D. and Lone Star claims and copper ore from the Little Mildred and McIntosh properties.

Bullard (Pierce) district.—Bullard Gold Mines, Inc., worked the Bullard mine continuously in 1941 and shipped about 1,800 tons of gold-copper ore to a smelter. The rest of the district output was mainly copper ore from the Little Giant mine.

Castle Creek district.—The principal output of the Castle Creek district in 1941 was crude lead ore from the Montezuma and Palona King properties and gold ore from the Gold Rock and King Bolt mines.

Cherry Creek district.—All the output of the Cherry Creek district in 1941 was crude gold ore shipped to smelters; the chief producers were the Sugar Bowl, Sensation, Black Hawk, Volcano, Gray Eagle, and Gold Pick properties.

Copper Basin district.—Placer gold was the principal output in the Copper Basin district in 1941; the Queen of Sheba claim was the largest producer.

Eureka district.—Production of gold, silver, copper, lead, and zinc in the Eureka district in 1941 was much greater than in 1940, owing to increased output of zinc-lead ore from the Hillside mine and copper ore from the Bagdad property. All of the zinc and most of the gold, silver, and lead output of the district were recovered from the treatment of 31,450 tons of zinc-lead ore from the Hillside mine, and nearly all the copper output was recovered from the treatment of 88,209 tons of copper ore from the Bagdad property.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.—About 1,700 tons of ore were produced in the Hassayampa district in 1941 compared with 2,512 tons in 1940; most of it was gold ore from the Climax Extension, Oro Flame, Alma, Eureka, Railroad, Sacramento, Big Chief, Mohawk, U. P., Golden Summer, Nevada, and Infanta properties. The most important producer was the Oro Flame mine. Placer gold was recovered chiefly at the Hobbs property by a dragline floating dredge working the last 10 days of the year.

Humbug district.—A little gold ore was produced in 1941 from the Humbug Gold Mines property, and 139 tons of old tailings (gold)

were shipped from a dump; placer gold and silver were recovered by various operators working along Cow, French, and Humbug Creeks.

Kirkland district.—All the output of the Kirkland district in 1941 was crude gold ore, mainly from the Venus mine.

Lynx Creek district.—The output of placer gold in the Lynx Creek district was 4,372 fine ounces in 1941, an increase of 2,342 ounces over 1940. The gain resulted from operation of a dragline flotation dredge at the Peach & Brown property by the Big Bug Dredging Co. The rest of the district placer gold was recovered, chiefly by dredges, at the Fitzmaurice and Speck-Lynx Creek properties.

Martinez (Congress) district.—Gold and silver recovered from old tailings and waste-dump ore at the Congress property continued in 1941 to be the chief production of the Martinez district; 49,712 tons of ore and 50,068 tons of old tailings were treated by cyanidation in 1941 compared with a total of 91,307 tons of ore and old tailings in 1940.

Peck district.—In 1941 crude silver ore (223 tons) from the Swastika mine was the only output in the Peck district.

Pine Grove district (Crown King).—The Gladiator Mining Co. worked the Gladiator-War Eagle group throughout 1941 and shipped 4,759 tons of gold ore containing some silver and copper. The remainder of the district output was principally gold ore and old tailings from the Golden Crown property and crude gold-lead ore from the Del Pasco mine.

Silver Mountain district (Wagoner).—Nearly all the output of the Silver Mountain district in 1941 was crude silver ore from the Little Joker mine.

Squaw Creek district.—A little gold ore was produced in 1941 from the Gold Crown claim near Canyon.

Tiger district.—About 262 tons of gold ore and 22 tons of gold-silver ore were produced in the Tiger district in 1941; the chief producers were the Oro Belle, Fortuna, and Pilgrim properties.

Turkey Creek district.—The principal output of the Turkey Creek district in 1941 was crude gold ore from the Issaquah, Parker, and Cumberland properties.

Verde district (Jerome).—Production of gold, silver, and copper in the Verde district was much greater in 1941 than in 1940, owing to increased output of copper ore from the United Verde mine of the Phelps Dodge Corporation; the total output of ore and old tailings from the property was 1,097,546 tons in 1941 compared with 882,319 tons in 1940.

According to the printed annual report of the corporation for 1941, the United Verde mine produced 838,454 tons of copper ore from underground operations; as in past years, a large part of the total ore mined was recovered from pillars. Stoping operations were much larger than in 1940, and all available ore areas were worked to the extent possible under proper mining sequence. Total development for the year amounted to 20,597 feet, including 15,653 feet of diamond drilling and 656 feet of sinking at the No. 8 shaft. Material reclaimed from ore dumps totaled 239,318 tons, production of precipitates amounted to 690 tons, and the concentrator treated 651,552 tons of copper ore.

Lessees continued to work the Iron King-Equator group and shipped 20,580 tons of gold-silver ore to a smelter. The rest of the district output was principally crude copper ore from the Green Flower property.

Walker district.—About 8,360 tons of ore were produced in the Walker district in 1941—a marked increase over 1,668 tons in 1940; nearly 96 percent of the output was gold-silver-copper ore concentrated from the Sheldon property. The remainder was largely crude gold ore from the Four Boys, Oro Plata, Alturas, Lost Wonder, and Emma properties. Placer gold and silver were recovered by various small-scale operators working on Lynx Creek near Walker.

Walnut Grove district.—Nearly all the output in the Walnut Grove district in 1941 was crude copper ore from the Copper Crown and Red Devil claims and gold ore from the Granite group.

Weaver district (Octave).—Production of gold in the Weaver district was 20,190 fine ounces in 1941, a gain of 871 ounces over 1940; 94 percent of the total came from three properties—the Octave, Alvarado, and Yarnell. The most important producer continued to be the Octave mine, operated by the American Smelting & Refining Co.; 27,951 tons of gold ore were treated by flotation, and the flotation tailings were cyanided. About 40,150 tons of gold ore from the Yarnell mine and 36,372 tons of similar ore from the Alvarado mine were treated in cyanide plants. Other producers of gold ore included the Johnson, "94," Rincon, Monica, York (Rees), and Koerber properties. Placer gold was recovered chiefly from the Sunshine, Merrill, and Home claims.

White Picacho district.—The Eugenia group was operated in 1941, and 446 tons of crude copper-silver ore were shipped to a smelter. The rest of the district output was mainly gold ore from the Young property.

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Castle Dome district.—The most important output in the Castle Dome district in 1941 was placer gold recovered at the Ocatilla property by a Stebbins dry concentrator. The chief producer of lode gold was the Southern Extension mine.

Cienega district.—Lessees operated the Empire mine in 1941 and shipped 325 tons of gold-copper ore to various smelters in Arizona. The rest of the district output was mainly crude gold ore from the Golden Ray group.

Dome (Gila City) district.—All the output of the Dome district in 1941 was placer gold recovered by various operators working along the Gila River near Dome.

Ellsworth district (Salome).—Of the total ore (659 tons) produced in the Ellsworth district in 1941, about 45 percent was numerous small lots of crude gold ore and gold-copper ore sold to the Wickenburg Ore Market. The remainder was principally crude copper ore from the Moore group and gold ore from the Bunker Hill, Critic, Dandy, and Hercules properties, shipped to a smelter.

Eureka district.—The Penn Metals, Inc., operated the Red Cloud mine a few months in 1941 and treated about 3,300 tons of lead-silver ore by flotation.

Kofa district.—Small lots of ore averaging 10 ounces of gold to the ton were produced in 1941 from the Oakland claim; gold ore was produced also from the Blue Bird, Katy Ross, and Sheep Tanks properties. Placer gold was recovered from the Kofa claim.

Laguna district.—In 1941, as in 1940, all the output of the Laguna district was placer gold recovered by various operators working in the Laguna Dam area.

La Paz and Middle Camp district.—The principal output in the La Paz and Middle Camp district in 1941 was placer gold recovered largely from the Golden Anchor (Jones) property. Small lots of high-grade gold-copper ore were produced from the Copper Bottom claim.

Mohawk district.—The Red Cross mine was operated in 1941, and 33 tons of silver ore were shipped to a smelter.

Plomosa and La Cholla district.—A total of 1,771 tons of ore was produced in the Plomosa and La Cholla district in 1941 compared with 3,017 tons in 1940. The chief output was crude gold ore from the Little Butte mine and crude silver ore from the R. & A. property. The marked decrease in output of placer gold resulted from suspension in February of drift mining at the Arizona Drift property. Other placer producers included the Can Do (Erdman) and Yell claims.

Santa Maria (Planet, Bill Williams) district.—The only output in the Santa Maria district in 1941 was old mill clean-up material containing chiefly copper from the Swansea property.

Trigo district.—All the output of the Trigo district in 1941 was placer gold recovered by various operators working gravel in dry washes.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

SUMMARY

After an uninterrupted rise from $12,066,750 in 1932 to $54,268,690 in 1940, the total value of gold, silver, copper, lead, and zinc produced from California ore, old tailings, and gravels declined in 1941 to $52,231,066 (see fig. 1). Higher wages, migration of miners to war industries, rising prices of supplies and materials and difficulties in obtaining them, increased taxes, and fixed prices for gold and silver (the most important of the five metals in California) were factors in reversing the upward trend that had more than quadrupled in 8 years the value of the metals covered by this survey.

Comparing 1941 with 1940, the decline in total value for the five metals was 4 percent; gold decreased 3 percent and silver 9 percent in both quantity and value, copper decreased 39 percent in quantity and 36 percent in value, lead increased 95 percent in quantity and 123 percent in value, and zinc increased 457 percent in quantity and 563 percent in value. Of the total value of the five metals in 1941, gold represented 94 percent, silver 3 percent, copper 2 percent, and lead and zinc combined 1 percent.

Despite a 10-percent decline for 1941 in total value of production, Nevada County continued to be the largest contributor to the metal-mining output of California; it supplied 20 percent of the State total value of the five metals, 20 percent of the total gold, and 39 percent of the lode gold. Sacramento County (largely from gold dredging) contributed 12 percent of the total value of the five metals; Amador County (three-fourths from gold ore and one-fourth from placer gravels) and Kern County (largely from gold and gold-silver ores), 7 percent each; Yuba County (largely from gold dredging) and Butte County (largely from placer gravels), 6 percent each; Calaveras County (almost two-thirds from gold ore and one-third from placer gravels) and Siskiyou County (largely from placer gravels), 5 percent each; and Plumas County (largely from gold and copper ores), 4 percent. Thus, the foregoing 9 of the 40 counties producing the metals in California in 1941 contributed over 2 million dollars each to the State total value and supplied nearly three-fourths of that total.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937-41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0 7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938-41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in California, 1937-41, and total, 1848-1941, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	913	838	4,925,014	1,174,578	$41,110,230	2,888,265	$2,234,073
1938	927	676	4,648,249	1,311,129	45,889,515	2,590,804	1,674,863
1939	1,028	749	5,577,853	1,435,264	50,234,240	2,599,139	1,764,264
1940	1,030	836	4,669,433	1,455,671	50,948,485	2,359,776	1,678,063
1941	835	724	4,280,185	1,408,793	49,307,755	2,154,188	1,531,867
1848-1941			(2)	100,262,759	2,211,300,217	103,032,188	83,335,903

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	10,502,000	$1,270,742	2,372,000	$139,948	40,000	$2,600	$44,757,593
1938	1,612,000	157,976	990,000	45,540			47,767,894
1939	8,360,000	869,440	1,052,000	49,444	12,000	624	52,918,012
1940	12,876,000	1,454,988	3,544,000	177,200	158,000	9,954	54,268,690
1941	7,886,000	930,548	6,928,000	394,896	880,000	66,000	52,231,066
1848-1941	[3] 592,570	192,203,568	[3] 125,852	14,764,921	[3] 52,483	9,455,464	2,511,060,073

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figures not available.
[3] Short tons.

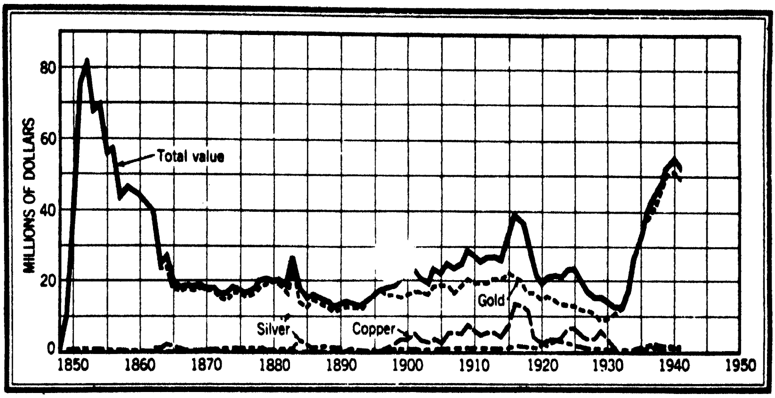

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848–1941. The value of lead and zinc has exceeded $1,000,000 in only a few years.

Gold produced at placer mines in California, 1937–41, by classes of mines and by methods of recovery, and total, 1848–1941 [1]

Class and method	Mines producing [2]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers:						
Gravel mechanically handled:						
Connected-bucket dredges:						
1937	33	46	94,809,000	322,961	$11,303,635	$0.119
1938	33	48	117,080,000	375,296	13,135,360	.112
1939	34	47	121,655,000	370,264	12,959,240	.107
1940	32	46	132,461,000	414,966	14,523,810	.110
1941	37	47	135,757,000	418,282	14,639,870	.108
Dragline dredges:						
1937	51	47	19,364,000	94,142	3,294,970	.170
1938	77	68	24,560,000	118,108	4,133,780	.168
1939	142	109	31,618,000	172,519	6,038,165	.191
1940	198	106	42,747,000	205,181	7,181,335	.168
1941	234	112	45,579,000	225,019	7,875,665	.173
Becker-Hopkins dredges:						
1940 [3]	2	2	35,000	148	5,180	.148
1941	3	2	52,000	244	8,540	.164
Suction dredges: [4]						
1940 [3]	4	4	64,000	584	20,440	.319
1941	17	17	357,000	1,763	61,705	.173
Nonfloating washing plants: [5]						
1937	58	53	2,338,000	17,079	597,765	.256
1938	74	71	3,538,000	23,046	806,610	.228
1939	114	101	5,512,000	41,694	1,459,290	.265
1940	131	105	5,908,000	28,232	988,120	.167
1941	85	76	5,656,000	28,703	1,004,605	.178
Gravel hydraulically handled:						
Hydraulic:						
1937	82		1,324,000	4,628	161,980	.122
1938	86		1,719,000	7,061	247,135	.144
1939	74		921,000	6,059	212,065	.230
1940	92		2,401,000	12,059	422,065	.176
1941	79		2,886,000	10,145	355,075	.123

See footnotes at end of table.

Gold produced at placer mines in California, 1937–41, by classes of mines and by methods of recovery, and total, 1848–1941—Continued

Class and method	Mines producing	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers—Continued.						
Small-scale hand methods: [6]						
Wet:						
1937	463		2,209,000	25,612	$896,420	$0.406
1938	292		2,863,500	41,686	1,459,010	.510
1939	267		2,534,100	38,815	1,358,525	.536
1940	[7] 278		[8] 1,710,200	[7] 38,526	[7] 1,348,410	[7] .788
1941	182		1,599,700	29,040	1,016,400	.635
Dry:						
1937	30		14,000	486	17,010	1.215
1938	15		6,500	172	6,020	.926
1939	25		11,900	169	5,915	.497
1940	17		10,800	211	7,385	.684
1941	13		7,300	220	7,700	1.055
Underground placers:						
Drift:						
1937	121		98,000	7,398	258,930	2.642
1938	99		97,000	7,144	250,040	2.578
1939	94		83,000	6,525	228,375	2.752
1940	96		88,000	5,045	176,575	2.007
1941	74		90,000	4,597	160,895	1.788
Grand total placer:						
1937	838		120,156,000	472,306	16,530,710	.138
1938	676		149,864,000	572,513	20,037,955	.134
1939	[9] 749		162,335,000	636,045	22,261,575	.137
1940	[9] 836		[8] 185,425,000	704,952	24,673,320	.133
1941	724		191,984,000	718,013	25,130,455	.131
1848–1941			(10)	64,540,142	1,394,642,616	(10)

[1] For data by years before 1937 see Minerals Yearbook, Review of 1940, p. 219.
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property worked.
[3] First year for which this method was reported used in California.
[4] Includes all placer operations using suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold which are included under "Small-scale hand methods."
[5] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[6] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[7] Figures changed to exclude suction dredges. See footnote 4.
[8] Revised figures.
[9] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.
[10] Complete data not available.

Gold.—After an uninterrupted rise from 1929 to 1940, the quantity and value of California gold production in 1941 fell below that of 1940. The reversal in trend was due entirely to the decline in lode mining; placer-gold output continued to rise and exceeded that for any year since 1862.

The 25 leading gold-producing mines in California in 1941, listed in the following table, yielded 54 percent of the total gold output of the State. In 1941, three lode mines (gold ore) and two placers (connected-bucket dredges) displaced two lode mines (gold ore) and three placers (two connected-bucket dredges and one dragline dredge) which were on the 1940 list; of those displaced, one connected-bucket dredge and the dragline-dredge operations were reported worked out and one of the lode operations lost its identity by merger with its neighbor.

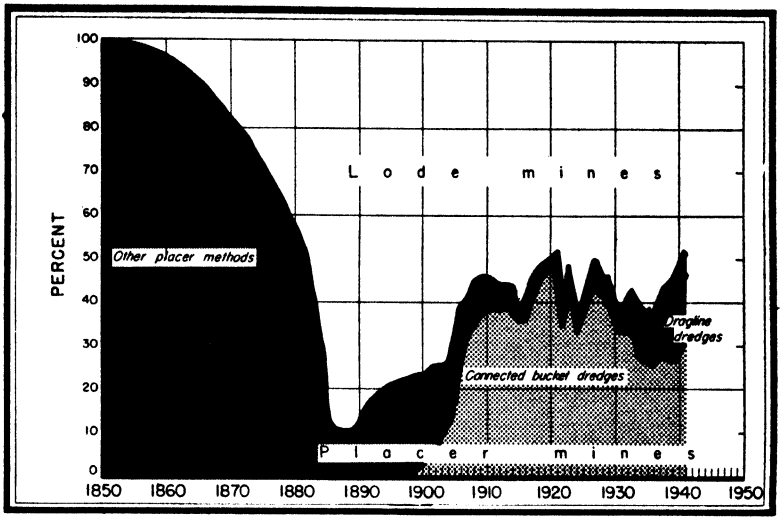

FIGURE 2.—Percentage of total California gold produced at lode and placer mines and by various methods of placer mining, 1850–1941.

Twenty-five leading gold-producing mines in California in 1941, in order of output

Rank	Mine	District	County	Rank in 1940	Operator	Source of gold
1	Idaho Maryland-Brunswick.	Grass Valley-Nevada City.	Nevada	1	Idaho Maryland Mines Corporation.	Gold ore.
2	Natomas Co.	Folsom	Sacramento	3	Natomas Co.	Dredge.
3	Empire Star Mines	Grass Valley-Nevada City.	Nevada	2	Empire Star Mines Co., Ltd.	Gold ore
4	Yuba Unit	Yuba River	Yuba	4	Yuba Consolidated Gold Fields.	Dredge.
5	Lava Cap	Grass Valley-Nevada City.	Nevada	5	Lava Cap Gold Mining Corporation.	Gold ore.
6	Butte Unit	Oroville	Butte	6	Yuba Consolidated Gold Fields.	Dredge.
7	Central Eureka	Mother Lode	Amador	7	Central Eureka Mining Co.	Gold ore.
8	Capital Dredges	Folsom	Sacramento	8	Capital Dredging Co.	Dredge.
9	Golden Queen	Mojave	Kern	12	Golden Queen Mining Co.	Gold ore.
10	Carson Hill	Mother Lode	Calaveras	9	Carson Hill Gold Mining Corporation.	Do.
11	Argonaut	do	Amador	11	Argonaut Mining Co.	Do.
12	Alabama	Ophir	Placer	15	Alabama California Gold Mines Co.	Do.
13	Cactus Queen	Mojave	Kern	13	Cactus Mines Co.	Do.
14	Sliger	Mother Lode	Eldorado	23	Middle Fork Gold Mining Co.	Do.
15	Sheepranch	East Belt	Calaveras	10	St. Joseph Lead Co.	Do.
16	Snelling	Snelling	Merced	16	Snelling Gold Dredging Co.	Dredge.
17	Original Sixteen to One.	Alleghany	Sierra	19	Original Sixteen to One Mine, Inc.	Gold ore.
18	Iron Mountain	Flat Creek (Iron Mountain).	Shasta	14	The Mountain Copper Co., Ltd.	Gold ore and copper ore.
19	Walker	Genesee	Plumas	17	Walker Mining Co.	Copper ore.
20	Ohio Point (Virgilia).	Rich Bar	do	30	Virgilia Mining Corporation.	Gold ore.
21	Keystone	Mother Lode	Amador	27	Keystone Mine Syndicate.	Do.
22	Surcease	Yankee Hill	Butte	36	Hoefling Bros	Do.
23	Merced dredge	Snelling	Merced	28	Merced Dredging Co.	Dredge.
24	Putnam property	Camanche	San Joaquin	82	Gold Hill Dredging Co.	Do.
25	Siskiyou Unit	Callahan	Siskiyou	20	Yuba Consolidated Gold Fields.	Do.

Silver.—The bulk of the silver output of California in 1941 was more localized than that of the gold; the 10 leading silver-producing mines, listed in the following table, yielded 80 percent of the State total recoverable silver in that year. The list is similar to that of 1940, except for some changes in rank, the exclusion of the Iron Mountain mine (Shasta County) and the Standard mine (Mono County), and the inclusion of the Columbia No. 2 mine (Inyo County) and the Alabama mine (Placer County). In addition to the mines listed, some silver was recovered from almost every lode and placer mine operating in the State in 1941.

Ten leading silver-producing mines in California in 1941, in order of output

Rank	Mine	District	County	Rank in 1940	Operator	Source of silver
1	Cactus Queen	Mojave	Kern	1	Cactus Mines Co	Gold-silver ore.
2	Lava Cap	Grass Valley-Nevada City.	Nevada	2	Lava Cap Gold Mining Corporation.	Gold ore.
3	Golden Queen	Mojave	Kern	4	Golden Queen Mining Co.	Do.
4	Starlight	do	do	5	Lodestar Mining Co	Do.
5	Walker	Genesee	Plumas	3	Walker Mining Co	Copper ore
6	Columbia No. 2	Resting Springs	Inyo	12	Shoshone Mines, Inc	Lead ore.
7	Kelly	Randsburg	San Bernardino.	7	F. Royer and lessees	Gold-silver ore.
8	Empire Star Mines	Grass Valley-Nevada City.	Nevada	10	Empire Star Mines Co., Ltd	Gold ore.
9	Alabama	Ophir	Placer	11	Alabama California Gold Mines Co.	Do
10	Grigsby (Palisade)	Calistoga	Napa	6	Helena Consolidated Mines, Inc	Gold-silver ore

Copper.—Copper production in California decreased materially with the suspension of operations at the Walker mine in the Genesee district of Plumas County, October 31, 1941; during the year this mine contributed over 92 percent of the State copper output of 7,886,000 pounds.

Lead.—Lead production in California increased 95 percent in quantity and 123 percent in value in 1941 compared with 1940. Shoshone Mines, Inc., which operated the Columbia No. 2 mine in the Resting Springs district of Inyo County, and Imperial Metals, Inc., which operated the Black Eagle mine in the Eagle Mountain district of Riverside County until work was suspended early in the year, supplied 94 percent of the State total.

Zinc.—Zinc production in California, although still very small, increased 457 percent in quantity and 563 percent in value in 1941 compared with 1940; 96 percent of the zinc was recovered from ores shipped by E. H. Snyder from the Colorado group in the Modoc district of Inyo County and by W. F. Houston from the Carbonate King mine in the Ivanpah district of San Bernardino County. Much of the ore from both mines was converted to zinc oxide at the Richmond plant of the Western Zinc Oxide Co (operated under lease after September 18, 1941, by the Pacific Zinc Oxide Co.).

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1941, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	1		136	$4,760			136	$4,760
Amador	23	40	75,023	2,625,805	24,957	$873,495	99,980	3,499,300
Butte	14	52	11,620	406,700	73,554	2,574,390	85,174	2,981,090
Calaveras	43	61	46,148	1,615,180	28,520	998,200	74,668	2,613,380
Del Norte		1			39	1,365	39	1,365
Eldorado	50	44	20,639	722,365	23,579	825,265	44,218	1,547,630
Fresno	5	7	27	945	6,089	213,115	6,116	214,060
Humboldt		6			382	13,370	382	13,370
Imperial	10	2	2,427	84,945	52	1,820	2,479	86,765
Inyo	71	4	16,063	562,205	33	1,155	16,096	563,360
Kern	97	11	79,740	2,790,900	288	10,080	80,028	2,800,980
Lassen	6		61	2,135			61	2,135
Los Angeles	9	4	5,083	177,905	88	3,080	5,171	180,985
Madera	12	20	301	10,535	1,196	41,860	1,497	52,395
Mariposa	53	30	22,664	793,240	9,938	347,830	32,602	1,141,070
Merced		8			44,313	1,550,955	44,313	1,550,955
Mono	36	1	9,500	332,500	5	175	9,505	332,675
Monterey	1		17	595			17	595
Napa	1		350	12,250			350	12,250
Nevada	32	32	270,596	9,470,860	11,469	401,415	282,065	9,872,275
Orange	1		18	630			18	630
Placer	24	59	25,388	888,580	15,805	553,175	41,193	1,441,755
Plumas	25	29	30,272	1,059,520	5,984	209,440	36,256	1,268,960
Riverside	31	3	1,690	59,150	8	280	1,698	59,430
Sacramento	2	20	13	455	179,632	6,287,120	179,645	6,287,575
San Bernardino	117	10	16,649	582,715	298	10,430	16,947	593,145
San Diego	7		301	10,535			301	10,535
San Francisco		(2)			19	665	19	665
San Joaquin		10			23,741	830,935	23,741	830,935
San Luis Obispo		1			9	315	9	315
Santa Cruz		(2)			9	315	9	315
Shasta	26	32	19,857	694,995	29,279	1,024,765	49,136	1,719,760
Sierra	17	39	16,829	589,015	10,533	368,655	27,362	957,670
Siskiyou	50	93	1,801	63,035	65,393	2,288,755	67,194	2,351,790
Stanislaus		7			25,472	891,520	25,472	891,520
Trinity	18	67	429	15,015	42,453	1,485,855	42,882	1,500,870
Tulare	3		75	2,625			75	2,625
Tuolumne	42	10	13,199	461,965	9,798	342,930	22,997	804,895
Ventura	2	2	17	595	2	70	19	665
Yuba	6	19	3,847	134,645	85,076	2,977,660	88,923	3,112,305
	835	724	690,780	24,177,300	718,013	25,130,455	1,408,793	49,307,755
Total, 1940	1,030	836	750,719	26,275,165	704,952	24,673,320	1,455,671	50,948,485

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	325	$231			325	$231
Amador	20,226	14,383	3,049	$2,168	23,275	16,551
Butte	23,881	16,982	5,884	4,184	29,765	21,166
Calaveras	12,212	8,684	2,708	1,926	14,920	10,610
Del Norte			3	2	3	2
Eldorado	2,935	2,087	2,994	2,129	5,929	4,216
Fresno	3	2	973	692	976	694
Humboldt			55	39	55	39
Imperial	509	362			509	362
Inyo	159,227	113,228			159,227	113,228
Kern	868,126	617,334	66	47	868,192	617,381
Lassen	62	44			62	44

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Output from property not classed as a "mine."

Mine production of gold, silver, copper, lead, and zinc in California in 1941, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Los Angeles	2,274	$1,617	13	$9	2,287	$1,626
Madera	128	91	343	244	471	335
Mariposa	7,785	5,536	2,316	1,647	10,101	7,183
Merced			4,555	3,239	4,555	3,239
Mono	44,446	31,606			44,446	31,606
Monterey	7	5			7	5
Napa	36,121	25,686			36,121	25,686
Nevada	443,385	315,296	1,350	960	444,735	316,256
Orange	4,846	3,446			4,846	3,446
Placer	54,339	38,641	2,087	1,484	56,426	40,125
Plumas	180,076	128,054	539	383	180,615	128,437
Riverside	32,400	23,040			32,400	23,040
Sacramento	3	2	10,229	7,274	10,232	7,276
San Bernardino	162,873	115,821	20	14	162,893	115,835
San Diego	50	36			50	36
San Francisco			3	2	3	2
San Joaquin			2,011	1,430	2,011	1,430
San Luis Obispo						
Santa Cruz			3	2	3	2
Shasta	22,882	16,272	2,890	2,055	25,772	18,327
Sierra	3,628	2,580	896	637	4,524	3,217
Siskiyou	564	401	9,470	6,734	10,034	7,135
Stanislaus			2,314	1,646	2,314	1,646
Trinity	173	123	4,619	3,285	4,792	3,408
Tulare	56	40			56	40
Tuolumne	4,870	3,463	905	644	5,775	4,107
Ventura	5	4			5	4
Yuba	296	210	5,180	3,684	5,476	3,894
	2,088,713	1,485,307	65,475	46,560	2,154,188	1,531,867
Total, 1940	2,295,606	1,632,431	64,170	45,632	2,359,776	1,678,063

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$4,991
Amador	8,000	$944	14,000	$798			3,517,593
Butte							3,002,256
Calaveras	8,000	944					2,624,934
Del Norte							1,367
Eldorado	2,000	236					1,552,082
Fresno							214,754
Humboldt							13,409
Imperial							87,127
Inyo	286,000	33,748	5,312,000	302,784	438,000	$32,850	1,045,970
Kern	2,000	236	18,000	1,026			3,419,623
Lassen							2,179
Los Angeles	2,000	236					182,847
Madera							52,730
Mariposa	4,000	472	8,000	456			1,149,181
Merced							1,554,194
Mono	4,000	472	30,000	1,710			366,463
Monterey							600
Napa	2,000	236					38,172
Nevada	26,000	3,068	10,000	570			10,192,169
Orange			14,000	798	32,000	2,400	7,274
Placer	8,000	944	44,000	2,508			1,485,332
Plumas	7,288,000	859,984	68,000	3,876			2,261,257
Riverside	10,000	1,180	1,368,000	77,976			161,626
Sacramento							6,294,851
San Bernardino	106,000	12,508	32,000	1,824	410,000	30,750	754,062
San Diego							10,571
San Francisco							667
San Joaquin							832,365
San Luis Obispo							315
Santa Cruz							317
Shasta	118,000	13,924					1,752,011
Sierra	2,000	236	10,000	570			961,693
Siskiyou							2,358,925
Stanislaus							893,166
Trinity							1,504,278
Tulare							2,665

Mine production of gold, silver, copper, lead, and zinc in California in 1941, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Tuolumne	10,000	$1,180					$810,182
Ventura							669
Yuba							3,116,199
Total, 1941	7,886,000	930,548	6,928,000	$394,896	880,000	$66,000	52,231,066
Total, 1940	12,876,000	1,454,988	3,544,000	177,200	158,000	9,954	54,268,690

MINING INDUSTRY

The tonnage of material from lode mines in California treated in 1941 decreased 8 percent compared with 1940, but the yardage at placer mines increased 4 percent; the output of lode gold declined 8 percent, but that of placer gold rose 2 percent. The average grade of lode material remained unchanged, but the average recoverable gold content of gravels declined 2 percent. Of the State total gold output in 1941, 49 percent was from lode mines and 51 percent from placers; this was the first year since 1927 that placer-gold production had exceeded that from lode mines.

Dredges of the connected-bucket type handled 71 percent of the gravel mined and recovered 58 percent of the State total placer gold in 1941.

The next most important method of placer mining—dragline dredging—continued in 1941 its spectacular rise as a means of recovering gold. The first dragline-dredge production in the United States was reported in California in 1933, when three outfits began work late in the year and recovered less than 100 ounces of gold. In 1941, 112 dragline dredges worked 234 properties; they washed 24 percent of the total placer gravel and recovered 31 percent of the total placer gold. The following table gives partial data on equipment in the dragline-dredge industry over a 3-year period; information on bucket size was supplied for 52 dredges in 1939, 89 in 1940, and 94 in 1941.

Size of buckets (cubic yards)	Number of boats			Size of buckets (cubic yards)	Number of boats		
	1939	1940	1941		1939	1940	1941
7½		1		1¾	2	3	8
6	1		2	1½	17	25	19
5		2	6	1¼	5	9	6
4		1		1	4	9	6
3½	1			⅞			1
3	3	4	5	¾	1	7	8
2½	4	8	19	½	2	3	
2¼	2	1	1	⅜		1	
2	10	15	13				

The Becker-Hopkins type of dredge (single bucket on telescopic arm attached to dredge) made its first appearance in California in 1940, when units were installed in Fresno and Sacramento Counties. In 1941 two of these dredges worked two properties in Sacramento County and one in Butte County.

A small increase was reported in gold recovery and a small decrease in quantity of gravel handled at nonfloating washing plants to which

gravel was delivered by mechanical means. Equipment was moved from one property to another, as was the practice with dragline dredges, and 76 plants worked 85 properties. Some of these nonfloating washing plants are stationary; others are built to move on skids, wheels, tracks, or by other means. Dragline excavators, power shovels, slackline excavators, trucks, bulldozers, and other machines are used to deliver the gravel.

Hydraulic production of gold in 1941 declined compared with 1940, but the quantity of gravel washed increased. Output by small-scale hand methods (both wet and dry) and by drift mining decreased.

Consumption of quicksilver at California placer mines totaled 19,949 pounds in 1941 compared with 21,872 pounds in 1940. The following quantities of gold were recovered to the pound of quicksilver used in 1941 (1940 figures in parentheses): Connected-bucket dredging, 40 ounces (41); dragline dredging, 37 ounces (39); nonfloating washing plants with mechanical gravel handling, 42 ounces (10); hydraulicking, 22 ounces (12); small-scale hand operation, 15 ounces (15); and drift mining, 72 ounces (115).

ORE CLASSIFICATION

Of the 4,280,185 tons of ore (including 845,076 tons of old tailings) sold or treated in 1941, 90 percent was dry gold ore and old tailings, 7 percent copper ore, and most of the remainder dry gold-silver ore.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in California in 1941, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	3,004,662	843,376	[1] 646,386	[1] 985,692	[1] 376,700	111,100	- - -
Dry and siliceous gold-silver ore	117,968	15	28,716	736,469	18,600		
Dry and siliceous silver ore	577	1,685	27	19,225	-	14,000	32,000
	3,123,207	845,076	[1] 675,129	[1] 1,741,386	[1] 395,300	125,100	32,000
Copper ore	292,232		12,038	179,744	7,418,100	64,000	
Lead ore	18,338		3,611	166,879	72,300	6,731,800	- -
Lead-copper ore	2	-		167	100	200	- -
Zinc ore	1,330		2	537	200	6,900	848,000
Total, lode mines	3,435,109	845,076	[1] 690,780	[1] 2,088,713	[1] 7,886,000	6,928,000	880,000
Total, placers	-		718,013	65,475			- - - -
	3,435,109	845,076	[1] 1,408,793	[1] 2,154,188	[1] 7,886,000	6,928,000	880,000
Total, 1940	3,819,472	849,961	[1] 1,455,671	[1] 2,359,776	[1] 12,876,000	3,544,000	158,000

[1] Includes metals recovered from tungsten ore not included in material treated

METALLURGIC INDUSTRY

During 1941, as in former years, most of the ore and virtually all the old tailings were treated at amalgamation and cyanidation mills (with or without concentrating equipment); 90 percent of the total

ore and old tailings was treated at such mills in 1941. Almost all the remaining ore was treated at concentrating mills; only 44,810 tons of crude ore and 9 tons of old tailings were shipped for direct smelting. Smelters received 32,198 tons of flotation concentrates and 2,422 tons of gravity concentrates from California mine operators in 1941. Comparing 1941 with 1940, ore treated at amalgamation and cyanidation mills decreased 9 percent, quantity of old tailings treated remained virtually unchanged, quantity of material treated at concentrating mills decreased 20 percent, and quantity of crude ore and old tailings smelted increased 54 percent.

Quicksilver consumption at California amalgamation mills totaled 7,265 pounds, used in the treatment of 2,104,298 tons of material to recover 285,038 ounces of gold and 65,978 ounces of silver in 1941. In the treatment of 1,265,201 tons of ore, 838,135 tons of old tailings, and 3,996 tons of concentrates to recover 203,511 ounces of gold and 600,949 ounces of silver, cyanide consumption was 289,659 pounds of 91-percent sodium cyanide and 1,812,239 pounds of commercial calcium cyanide (50-percent NaCN equivalent); in terms of 98-percent NaCN, the consumption was 1,193,581 pounds or 0.57 pound to the ton. A substantial part of the cyanide was consumed at custom mills in California.

Companies producing most of California's lode gold in 1941 owned and operated their own metallurgical plants, but a number of custom mills were active. The leading operators of metallurgical plants receiving custom material were: Burton Bros., Inc., Rosamond, Kern County; Golden Queen Mining Co., Mojave, Kern County; Mineral Reduction Co., Benton, Mono County; Gold Crown Mining Co., Ltd., east of Twentynine Palms, San Bernardino County; and F. W. Royer, Red Mountain, San Bernardino County. All these mills were cyanidation plants and accepted ore and old tailings for treatment. The Idaho Maryland Mines Corporation and Empire Star Mines Co., Ltd., Grass Valley, Nevada County, cyanided some lots of concentrates. The largest metallurgical custom plant in California—the Selby lead plant of the American Smelting & Refining Co. at Selby, Contra Costa County—continued to be the State's only smelter.

Mine production of metals in California in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore, old tailings, and concentrates amalgamated	2,104,298	285,038	65,978			
Ore, old tailings, sands, slimes, and concentrates cyanided	2,225,102	232,695	771,977			
Concentrates smelted						
Flotation	[1] 32,198	[1] 146,182	[1] 946,320	[1] 7,582,700	165,300	183,300
Gravity	2,422	11,531	15,019	4,700	37,200	
Ore and old tailings smelted	44,819	15,334	289,419	298,600	6,725,500	696,700
Total, lode mines		[1] 690,780	[1] 2,088,713	[1] 7,886,000	6,928,000	880,000
Total, placers		718,013	65,475			
		[1] 1,408,793	[1] 2,154,188	7,886,000	6,928,000	880,000
Total, 1940		[1] 1,455,671	[1] 2,359,776	[1] 12,876,000	3,544,000	158,000

[1] Includes concentrates and metals from tungsten ore

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1941, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Alpine	423		9	3	5	127	322		
Amador	268, 514		38, 802	7, 914	2, 665	17, 821	4, 148	5, 300	12, 900
Butte	7, 823		325	59	28	117	34		
Calaveras	441, 660		19, 561	2, 496	2, 488	10, 654	4, 203	5, 400	
Eldorado	19, 757	420	6, 962	635	1, 813	12, 943	1, 251	2, 000	
Fresno	66		8		1	16	3		
Imperial	15, 429	64	740	167					
Inyo	281		67	15					
Kern	51, 783	1, 051	5, 672	2, 288	746	3, 159	9, 159	300	18, 000
Lassen	121		41	21					
Los Angeles	32, 678		3, 122	632	340	1, 038	1, 190	2, 000	
Madera	1, 623		279	114	7	22	14		
Mariposa	119, 217		9, 314	2, 558	2, 194	12, 080	4, 347	3, 800	8, 000
Mono	140, 766		4, 424	1, 962					
Nevada	642, 680		147, 906	26, 071	1, 405	38, 429	324, 923	26, 000	10, 000
Placer	115, 153		20, 374	6, 747	863	3, 734	45, 355	8, 000	43, 100
Plumas	3, 496	401	639	110	8	22	23		
Riverside	447		316	91					
Sacramento	1		7	2					
San Bernardino	15, 642		2, 300	9, 747	11	149	331		
San Diego	1, 050		176	27	8	110	14		
Shasta	7, 102		2, 571	571	464	2, 579	909	100	
Sierra	58, 633		15, 145	2, 846	495	1, 481	718	2, 000	10, 000
Siskiyou	2, 526		1, 341	289	12	49	24		
Trinity	918	212	296	55	10	55	31		
Tulare	424		56	42	4	14	7		
Tuolumne	135, 192		1, 869	434	1, 099	10, 867	4, 145	9, 900	
Ventura	65		15	5					
Yuba	18, 680		2, 701	77					
	2, 102, 150	2, 148	285, 038	65, 978	14, 666	115, 466	401, 151	64, 800	102, 000
Total, 1940	2, 410, 542	19, 432	339, 707	97, 618	26, 649	113, 467	369, 552	87, 000	104, 700

CYANIDATION MILLS

County	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Amador	30, 345	366, 679	16, 281	4, 659	6	243	1, 632	600	1, 100
Butte	78, 250		10, 364	21, 660	24	722	2, 084		
Calaveras	381, 326	437	15, 462	5, 165	2	17	7		
Eldorado	123		655	958					
Imperial	3, 236	64	1, 499	314					
Inyo	36, 114	1, 913	12, 088	6, 683	3	235	122		
Kern	224, 532	457, 816	57, 399	543, 653	213	13, 436	312, 542	1, 700	
Lassen	14		14	22					
Los Angeles	1, 439		923	444					
Mariposa		2, 969	227	143					
Mono	122, 753	55	3, 821	38, 515	97	1, 244	2, 854		
Nevada	206, 922	3, 800	84, 007	92, 255					
Placer	375		930	1, 388					
Plumas	26, 472		5, 633	1, 726					
Riverside	2, 081	71	1, 270	50					
San Bernardino	32, 894	2, 947	6, 141	35, 391	14	333	656		4, 400
San Diego	12		2						
Shasta	233, 725		14, 318	18, 448					
Sierra		5, 951	193	62					
Siskiyou	518	200	340	216					
Trinity		66	13	18					
Tuolumne		15	5	2					
Ventura	2		2						
Yuba	986		1, 108	205	2	4	3		
	1, 382, 119	842, 983	232, 695	771, 977	361	16, 234	319, 900	2, 300	5, 500
Total, 1940	1, 349, 167	826, 725	240, 574	833, 744	1, 134	20, 049	306, 457	13, 100	7, 000
Grand total: 1941	3, 484, 269	845, 131	517, 733	837, 955	15, 027	131, 700	721, 051	67, 100	107, 500
1940	3, 759, 709	846, 157	580, 281	931, 362	27, 783	133, 516	676, 009	100, 100	111, 700

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from concentrating mills in California in 1941, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Butte	150		12	85	40			
Calaveras	1,556		80	378	231	2,600		
Eldorado	20		3	6	36			
Fresno	10		1	3				
Inyo and Plumas [1]	369,226		[2] 18,947	[2] 23,780	[2] 197,328	[2] 7,515,300	77,400	145,300
Kern	250		[2] 10	[2] 74	[2] 484			
Lassen	10		1	6	19			
Mariposa	12,940		267	1,024	725	200		
Napa	6,599		116	350	36,121	2,000		
Nevada	950		24	210	84			
Orange	403		108	18	4,846		14,000	32,000
San Bernardino	101		16	4	286	200	3,600	6,000
Siskiyou	21		5	9	11			
Trinity	130		2	22	41			
Tuolumne	40		1	44	36			
	392,406		[2] 19,593	[2] 26,013	[2] 240,288	[2] 7,520,300	95,000	183,300
Total, 1940	489,699	10	[2] 24,914	[2] 27,828	[2] 415,475	[2] 10,795,200	160,000	158,000

[1] Combined to avoid disclosure of individual output.
[2] Includes concentrates and metals from tungsten ore not included in material treated.

Gross metal content of concentrates produced from ores mined in California in 1941, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	18,568	131,917	414,498	107,101	103,954	
Dry gold-silver	354	13,684	347,793	7,431	2,052	2,930
Dry silver	1		107			
Copper	15,352	11,976	193,968	7,746,560	85,766	
Lead	138	133	3,874	2,210	40,003	4,363
Zinc	207	3	1,099	520	8,103	229,829
	34,620	157,713	961,339	7,863,822	239,878	237,122
Total, 1940	52,697	161,344	1,091,484	11,278,562	329,052	228,531

Mine production of metals from California concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	5	127	322			
Amador	2,671	18,064	5,780	5,900	14,000	
Butte	64	924	2,158			
Calaveras	2,570	11,049	4,441	8,000		
Eldorado	1,816	12,949	1,287	2,000		
Fresno	2	19	3			
Inyo	605	326	19,324	227,700	9,400	145,300
Kern	969	16,669	322,185	2,000	18,000	
Lassen	1	6	19			
Los Angeles	340	1,038	1,190	2,000		
Madera	7	22	14			
Mariposa	2,461	13,104	5,072	4,000	8,000	
Mono	97	1,244	2,854			
Napa	116	350	36,121	2,000		
Nevada	1,429	38,639	325,007	26,000	10,000	
Orange	108	18	4,846		14,000	32,000
Placer	863	3,734	45,355	8,000	43,100	
Plumas	18,353	23,711	178,149	7,287,600	68,000	
San Bernardino	41	486	1,273	200	8,000	6,000
San Diego	8	110	14			
Shasta	464	2,579	909	100		
Sierra	495	1,481	718	2,000	10,000	
Siskiyou	17	58	35			
Trinity	12	77	72			
Tulare	4	14	7			
Tuolumne	1,100	10,911	4,181	9,900		
Yuba	2	4	3			
	34,620	157,713	961,339	7,587,400	202,500	183,300
Total, 1940	52,697	161,344	1,091,484	10,895,300	271,700	158,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	18,568	131,917	414,498	66,500	93,100	
Dry gold-silver	354	13,684	347,793	3,600	900	
Dry silver	1		107			
Copper	15,352	11,976	193,968	7,516,000	64,000	
Lead	138	133	3,874	1,100	37,100	
Zinc	207	3	1,099	200	7,400	183,300
	34,620	157,713	961,339	7,587,400	202,500	183,300

Gross metal content of California crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Material shipped		Gross metal content				
	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	19,127	9	9,667	19,943	96,561	3,966	
Dry and siliceous gold-silver	5,876		1,976	96,785	25,095	982	
Dry and siliceous silver	110		1	1,626	85		
Copper	764		90	4,366	122,960		
Lead	17,968		3,600	166,532	90,651	7,003,526	
Lead-copper	2			167	182	304	
Zinc	963					1,136	773,844
	44,810	9	15,334	289,419	335,534	7,009,914	773,844
Total, 1940	25,380	3,794	9,094	272,760	2,062,343	3,451,025	

Mine production of metals from California crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	1,545		1,876	1,873	2,100		
Butte	4		7	4			
Calaveras	81	8	76	110			
Eldorado	103		73	55			
Imperial	320		188	28			
Inyo	12,819		3,582	133,205	58,300	5,302,600	292,700
Los Angeles	1			8			
Mariposa	15		19	12			
Mono	193		11	1,115	4,000	30,000	
Monterey	17		17	7			
Nevada	11	1	44	52			
Placer	81		350	849		900	
Plumas	184		289	91	400		
Riverside	5,395		104	32,259	10,000	1,368,000	
Sacramento	1		6	1			
San Bernardino	22,917		7,722	116,462	105,800	24,000	404,000
San Diego	1		13	9			
Shasta	914		389	2,954	117,900		
Sierra	1		10	2			
Siskiyou	7		62	24			
Trinity	20		43	28			
Tulare	12		5	7			
Tuolumne	152		414	253	100		
Yuba	16		34	11			
	44,810	9	15,334	289,419	298,600	6,725,500	696,700
Total, 1940	25,380	3,794	9,094	272,760	1,980,700	3,272,300	

BY CLASSES OF ORE

	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	19,127	9	9,667	19,943	91,600	2,700	
Dry and siliceous gold-silver	5,876		1,976	96,785	15,000	900	
Dry and siliceous silver	110		1	1,626			
Copper	764		90	4,366	119,600		
Lead	17,968		3,600	166,532	72,300	6,720,900	
Lead-copper	2			167	100	200	
Zinc	963					800	696,700
	44,810	9	15,334	289,419	298,600	6,725,500	696,700

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in California in 1941, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Alpine County: Monitor	1		423	136		136	325				$4,991
Amador County:											
Camanche [4]		3			239	239	24				8,382
East Belt [5]	9	10	6,474	3,198	2,421	5,619	1,585	2,000			198,028
Ione		9			12,958	12,958	1,336				454,480
Mother Lode [6]	14	18	634,205	71,825	9,339	81,164	20,330	6,000	14,000		2,856,703
Butte County:											
Butte Creek	(7)	6	(7)	(7)	913	[8] 913	[8] 86				[8] 32,016
Enterprise		(9)			50	50	7				1,755
Forbestown	3	1	328	66	78	144	14				5,050
Golden Summit	1	(9)	15	2	21	23	3				807
Magalia	1	1	529	157	43	200	52				7,037
Merrimac	1	(9)	130	79	51	130	41				4,579
Oroville	4	43	903	72	68,787	68,859	5,161				2,413,735
Yankee Hill	2	1	77,202	11,113	3,611	14,724	24,363				532,665
Calaveras County.											
Camanche [4]		15			8,541	8,541	808				299,510
Campo Seco		6			779	779	93				27,331
Copperopolis	7		7,030	955		955	789	2,600			34,293
East Belt [5]	18	2	41,590	16,469	1,041	17,510	2,233	2,300			614,709
Jenny Lind [10]	(7)	12	(7)	(7)	8,589	[8] 8,589	[8] 629				[8] 301,062
Mother Lode [6]	17	26	418,448	27,038	9,570	36,608	9,257	3,100			1,288,229
Del Norte County:											
Crescent City (Beach)		(9)			13	13					455
French Hill		1			26	26	3				912
Eldorado County:											
East Belt [5]	7	8	3,061	1,144	3,588	4,732	2,000				167,042
Mother Lode [6]	32	29	72,649	19,311	15,694	35,005	3,424	2,000			1,227,846
West Belt	11	7	759	184	4,297	4,481	505				157,194
Fresno County:											
Auberry		(9)			127	127	35				4,470
Copper King	1		10	2		2					70
Friant		6			5,958	5,958	938				209,197
Sycamore	2	1	35	5	4	9					315
Temperance Flat	1		1	2		2					70
Humboldt County: Orleans		6			382	382	55				13,400

Imperial County:											
Cargo Muchacho	8	1	4,283	1,823	19	1,842	346				64,716
Mesquite Diggings	2	(9)	14,830	604	5	609	163				21,431
Picacho		(9)			21	21					735
Pot Holes		1			7	7					245
Inyo County:											
Alabama Hills	2		23	13		13	14				465
Bishop Creek	3		14	[11] 31		[11] 31	[11] 18,626	[11] 227,500			[11] 41,175
Carbonate	1		32	4		4	232		9,300		835
Chloride Cliff	10		1,837	742		742	1,391				26,959
Confidence	1		4	1		1	21		3,900		272
Coso	7		113	28		28	1,855		22,800		3,599
Echo Canyon	1		14	9		9	5				319
Fish Springs	4		62	28		28	31				1,002
Marble Canyon		3			22	22					770
Modoc	5		942	126		126	782	100	17,000	438,000	38,797
Olancha	1		300	6		6	31		3,300		420
Sherman	3		24,660	6,091		6,091	107				213,261
South Park	18		2,842	1,702		1,702	4,313	1,300	23,700		64,141
Ubehebe	1		3	9		9					315
Union	3	1	464	263	11	274	1,665				10,774
Waucoba	1		34				218		6,700		537
White Mountains	2		67	28		28	855		14,000		2,386
Wild Rose	6		8,386	3,641		3,641	3,673	100	48,700		132,835
Kern County:											
Amalie	3		2,024	263		263	125				9,294
China Grade		1			152	152	25				5,338
Cove	1		43,914	6,039		6,039	10,360	300	18,000		219,793
Goler	2	1	5	3	30	33	13				1,164
Greenhorn	2	1	9	3	5	8					280
Green Mountain	9	1	966	753	1	754	308				26,609
Havilah	6	2	203	61	20	81	55				2,874
Keyes	9	1	326	228	4	232	135				8,216
Mojave	23	1	218,731	60,218	1	60,219	853,009	1,700			2,714,450
Rademacher	4		163	53		53	7				1,860
Randsburg [12]	33	1	468,105	[11] 11,955	37	[11] 11,992	[11] 3,950				[11] 422,529
Red Rock	1		10				107				76
Sageland	2		170	149		149	77				5,270
Summit		1			1	1					35
White River	2	1	52	15	37	52	21				1,835
Lassen County:											
Diamond Mountain	2		64	28		28	24				997
Hayden Hill	2		70	25		25	17				887
Milford	2		11	8		8	21				295
Los Angeles County:											
Cedar	5		32,231	4,251		4,251	1,817	2,000			150,313
Iron Mountain	1		684	56		56	17				1,972
Muroc	2		39	96		96	45				3,392
Neenach	1		1,164	680		680	395				24,081
Palomas		1			28	28	10				987
San Gabriel		3			60	60	3				2,102

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1941, by counties and districts, in terms of recovered metals—Con.

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Madera County:											
Chowchilla River [13]		3			49	49	10				$1,722
Dennis		6			636	636	180				22,388
Hildreth	6	2	1,167	202	77	279	139				9,864
Potter Ridge	6	9	456	99	434	533	142				18,756
Mariposa County:											
East Belt [6]	18	3	4,930	1,445	83	1,528	352				53,730
Hunter Valley [14]	12	14	25,709	7,105	6,526	13,631	4,625	2,000			480,610
Mother Lode [6]	23	13	104,502	14,114	3,329	17,443	5,124	2,000	8,000		614,841
Merced County:											
Chowchilla River [13]		1			26	26	7				915
Hunter Valley [14]		2			1,103	1,103	239				38,775
Snelling		5			43,184	43,184	4,309				1,514,504
Mono County:											
Blind Springs	3		61	3		3	720				617
Bodie	4		122,813	5,476		5,476	35,661				217,019
Chidago	15		947	425		425	1,672		900		16,115
Homer	4	1	17,878	3,294	5	3,299	910				116,112
Mammoth Lakes	3		759	274		274	5,324	4,000	27,700		15,427
Masonic	3		12	11		11	41				414
Piute	3		24	13		13	118		1,400		619
West Walker River	1		60	4		4					140
Monterey County: Los Burros	1		17	17		17	7				600
Napa County: Calistoga	1		6,509	350		350	36,121	2,000			38,172
Nevada County:											
French Corral	2	(7)	35	10	(7)	[15] 10					[15] 350
Graniteville	3		30	20		20	7				705
Grass Valley-Nevada City	21	10	793,341	270,059	6,392	276,451	444,206	26,000	10,000		9,995,303
North Bloomfield	2	8	1,750	160	2,134	2,294	184				80,421
Washington	4	2	1,570	347	1,781	2,128	197				74,620
You Bet		10			709	709	72				24,806
Orange County: Santa Rosa	1		403	18		18	4,846		14,000	32,000	7,274
Placer County:											
Auburn	7	2	1,061	516	649	1,165	626		900		41,271
Canada Hill	1		13	6		6	3				212
Dutch Flat	1	6	2,180	371	954	1,325	156				46,486
Foresthill	5	6	240	99	901	1,000	131				35,098
Iowa Hill		9			1,219	1,219	169				42,786
Last Chance		10			508	508	52				17,817
Lincoln		3			1,129	1,129	173				39,688

Michigan Bluff		4			772	772	80				27,077
Ophir	10	19	111,740	24,396	9,673	34,069	55,036	8,000	43,100		1,234,958
Plumas County:											
Genesee	(?)	5	(?)	(?)	109	[8] 109	[8] 10	(?)	(?)		[8] 3,822
Granite Basin	3		104	37	54	91	17				3,197
Greenville	5	(?)	27,990	5,957	(?)	[15] 5,957	[15] 1,807	400			[15] 209,827
Johnsville	3	3	1,085	332	469	801	138				28,138
La Porte		5			685	685	62				24,019
Lights Canyon	2	1	714	74	1,673	1,747	156				61,256
Quincy	5	5	366	97	2,640	2,737	232				95,960
Seneca	3	6	76	68	127	195	63		4,000		7,098
Riverside County:											
Chuckawalla	3		17	231		231	38				8,112
Dale [16]	13	2	2,000	1,139	2	1,141	90		400		40,022
Eagle Mountain	4		5,446	128		128	32,244	10,000	1,367,600		106,542
Gold Park	2		288	103		103	4				3,606
Ironwood	4		149	66		66	17				2,322
Pinacate	4	1	89	21	6	27	7				950
Pinon	1		5	2		2					70
Sacramento County:											
Cosumnes River		7			31,660	31,660	2,301				1,109,736
Folsom	2	13	2	13	147,972	147,985	7,931				5,185,115
San Bernardino County:											
Amargosa	2		94	32		32	10				1,127
Amboy	2		44	48		48	24				1,697
Barstow	2		760	167		167	145				5,943
Bellville	7		159	140	1	141	62	200			5,008
Black Hawk	1		45	338		338	218				11,985
Buckeye	3		16,100	5,918		5,918	16,145	86,800			228,853
Calico	7		2,898	18		18	14,746	500			11,175
Clark Mountain	3		6,873	513		513	1,921	400	20,100		20,514
Coolgardie		3			55	55	7				1,930
Dale [16]	15		17,453	4,921		4,921	3,617				174,807
Fremont Peak	3		177	11		11					385
Goldstone	1		1	3		3					105
Hart	1		4,253	703		703	443				24,920
Holcomb Valley	(?)	3	(?)	(?)	216	[8] 216	[8] 10				[8] 7,567
Ivanpah	5		640	23		23	55	300	2,300	410,000	31,760
Kelso	2		1,481	189		189	495		4,400		7,218
Kramer Hills		1			11	11					385
New York Mountains	1		40	2		2	3				72
Old Woman Mountains	5		215	41		41	1,582				2,560
Paradise	1		370	18		18					630
Randsburg [13]	11	(?)	14,569	2,278	(?)	[15] 2,278	[15] 121,981	15,000			[15] 168,242
Signal	4		18	26		26	24	200			951
Silver Mountain	9		96	52		52	461		3,800		2,365
Slate Range	3		13	7		7	171	100	200		390
Soda Lake	1		2	1		1					35
Solo	6		298	495		495	249				17,502
Spangler	1		34	8		8					280

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1941, by counties and districts, in terms of recovered metals—Con.

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
San Bernardino County—Continued.											
Summit Valley		1			1	1					$35
Turtle Mountains	1		15	20		20	1				701
Vanderbilt	2		43	19		19	55	100	1,200		784
Whipple Mountains	14		144	58		58	64	2,400			2,359
San Diego County:											
Julian	4		34	24		24	12				849
Pine Valley	3		1,029	277		277	38				9,722
San Francisco County: San Francisco		(9)			19	19	3				667
San Joaquin County:											
Camanche [4]		6			16,572	16,572	1,762				581,273
Jenny Lind [10]		4			7,169	7,169	249				251,092
San Luis Obispo County: La Panza		1			9	9					315
Santa Cruz County: Santa Cruz		(9)			9	9	3				317
Shasta County:											
Flat Creek	2		232,964	13,368	100	13,468	19,382	117,900			499,075
French Gulch	12	(7)	17,183	5,386	(7)	[15] 5,386	[15] 3,088	100			[15] 190,718
Harrison Gulch	2		131	128		128	24				4,497
Igo		23			20,261	20,261	1,821				710,430
North Cow Creek		1			347	347	52				12,182
Old Diggings	1	1	2	47	102	149	93				5,281
Redding	1	2	1,261	443	2,944	3,387	464				118,875
Shasta	7	1	1,195	457	112	569	162				20,030
Slate Creek	1	2	60	28	105	133	24				4,672
Sierra County:											
Alleghany	9	7	48,552	14,442	559	15,001	2,814	900			527,142
Downieville	1	20	100	38	3,904	3,942	412				138,263
Gold Lake	1	(7)	105	35	(7)	[15] 35	[15] 7				[15] 1,230
Pike	2	2	13,022	2,100	142	2,242	842	1,100	10,000		79,769
Poker Flat	1	5	15	12	467	479	45				16,797
Sierra City	3	1	2,791	202	128	330	90				11,614
Siskiyou County:											
Callahan	4	11	191	127	15,386	15,513	2,100				544,448
Deadwood	5	3	207	186	2,328	2,514	421				88,289
Gazelle	1		120	14		14	7				495
Greenhorn	2	5	98	225	1,003	1,228	173				43,103
Humbug	4	7	142	65	2,912	2,977	509				104,557
Klamath River	13	31	761	448	38,307	38,755	5,836				1,360,575
Liberty	12	19	644	202	2,886	3,088	467				108,412
Quartz Valley	5	4	19	26	1,195	1,221	208				42,883
Salmon River	1	11	49	17	1,283	1,300	199				45,642

Scott Bar	3	1	1,041	491	82	573	114				20,136
Soda Creek		1			11	11					385
Stanislaus County:											
Knights Ferry		4			12,049	12,049	1,071				422,477
La Grange		3			13,423	13,423	1,243				470,689
Trinity County:											
Big Bar	1	3	30	19	282	301	37				10,561
Crow Creek	2	2	5	32	133	165	11				5,783
Hayfork	(7)	9	(7)	(7)	3,357	[8] 3,357	[8] 505				[8] 117,854
Helena	1	1	98	52	327	379	57				13,306
Junction City	1	8	49	15	11,710	11,725	1,083				411,145
Lewiston	5	12	796	181	5,695	5,876	627				206,106
New River	1	4	100	8	106	114	15				4,001
Salyer		1			956	956	71				33,510
Trinity Center	1	5	20	4	10,279	10,283	1,440				360,929
Weaverville	3	20	91	31	9,504	9,535	875				334,347
Tulare County:											
Camp Nelson	1		12	5		5	7				180
White River	2		424	70		70	49				2,485
Tuolumne County:											
East Belt [5]	30	2	3,32	1,850	481	2,331	748				82,117
Mother Lode [6]	11	8	130,967	11,198	9,317	20,515	4,982	10,000			722,748
West Belt	1		1,110	151		151	45				5,317
Ventura County:											
Piru	1	2	2	2	2	4					140
Snowey	1		65	15		15	5				529
Yuba County:											
Bear River		(9)			91	91	46				3,218
Browns Valley	1		18,600	3,686		3,686	273				129,204
Camptonville		6			270	270	31				9,472
Challenge	2	1	61	23	5	28	4				983
Dobbins	3	4	316	138	575	713	110				25,033
Smartville		4			8,934	8,934	668				313,165
Strawberry Valley		3			1,237	1,237	107				43,371
Yuba River		1			73,964	73,964	4,237				2,591,753
Other districts [17]	17	16	407,295	29,570	11,439	41,009	306,210	7,344,600	5,226,600		2,817,643
Total California	835	724	4,280,185	[11] 690,780	718,013	[11] 1,408,793	[11] 2,154,188	[11] 7,886,000	6,928,000	880,000	[11] 52,231,066

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 17 and their output included under "Other districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of total silver as follows. 2,088,713 ounces from lode mines and 65,475 ounces from placers.
[4] Camanche district lies in Amador, Calaveras, and San Joaquin Counties.
[5] East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[6] Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[7] Included under "Other districts."
[8] Exclusive of lode output, which is included under "Other districts."
[9] Output of property not classed as a "mine."
[10] Jenny Lind district lies in Calaveras and San Joaquin Counties.
[11] Includes metals from tungsten concentrates from ore not included in "Ore and old tailings" tonnage.
[12] Randsburg district lies in Kern and San Bernardino Counties.
[13] Chowchilla River district lies in Madera and Merced Counties.
[14] Hunter Valley district lies in Mariposa and Merced Counties.
[15] Exclusive of placer output, which is included under "Other districts."
[16] Dale district lies in Riverside and San Bernardino Counties.
[17] Includes following: Butte Creek district (lode) in Butte County; Jenny Lind (lode) in Calaveras County; Davis Flat in Fresno County; Resting Springs in Inyo County; French Corral (placer) in Nevada County; Genesee (lode), Greenville (placer), and Rich Bar in Plumas County; Holcomb Valley (lode), Randsburg (placer), and Ship Mountain in San Bernardino County; French Gulch (placer) in Shasta County; Depot Hill, Gold Lake (placer), and Port Wine in Sierra County; Coffee Creek and Hayfork (lode) in Trinity County.

ALPINE COUNTY

Monitor district.—Lessees worked the Zaca mine during 1941; the principal product was gold concentrates shipped to a smelter.

AMADOR COUNTY

Camanche district.—The Independence Gold Mines treated 12,100 cubic yards of gravel at a stationary washing plant between July 30 and October 12, 1941, recovering 187 ounces of gold and 19 ounces of silver.

East Belt district.—The Belama Corporation worked the Belden mine in the Volcano section of the East Belt during 1941 and treated 4,069 tons of ore in a 25-ton flotation mill; amalgamation, cyanidation, and smelting of concentrates yielded 2,079 ounces of gold and 634 ounces of silver. E. Schaefer shipped 145 tons of ore, containing 458 ounces of gold, 276 ounces of silver, and 2,575 pounds of copper, from the Elkhorn mine to a smelter. The Gwalia Gold Mining Co. worked the Pioneer mine and recovered gold by amalgamation and the smelting of flotation concentrates. Kent & Nimmo treated 1,500 tons of ore at the Three-in-One mine; bullion containing 170 ounces of gold and 51 ounces of silver was recovered by amalgamation, and table concentrates containing 18 ounces of gold, 15 ounces of silver, and 145 pounds of copper were shipped to a smelter. Garibaldi Bros. operated a nonfloating washing plant, to which gravel was delivered by mechanical means, at the Garibaldi mine, Pioneer Creek, one-half mile east of Volcano, intermittently during 1941; 33,200 cubic yards of gravel yielded 229 ounces of gold and 35 ounces of silver. The River Pine Mining Co. operated a dragline dredge near Aukum, which used a dragline excavator with a 1¾-cubic yard bucket, from January 1 to June 12, when it was moved to a site in Eldorado County near Nashville; 300,000 cubic yards of gravel yielded 1,380 ounces of gold and 192 ounces of silver.

Ione district.—The Amador Dredging Co. operated a dragline dredge in the Ione district during 1941. The Arroyo Seco Gold Dredging Co. operated an electric connected-bucket dredge, equipped with eighty-six 6-cubic foot buckets, from January 1 to May 15. The Lancha Plana Gold Dredging Co. operated an electric connected-bucket dredge, equipped with sixty-five 4½-cubic foot buckets, on Jackson Creek near Buena Vista from January 1 to May 4, when it was dismantled and moved to Butte Creek, Butte County. H. G. Kreth operated the Horton mine in Jackson Valley 5 miles south of Ione by hydraulicking from January to June and from October to December. McQueen and Downing operated a dragline dredge at the Irish Hill mine from March 28 to June 25. Lorentz and Swingle operated a dragline dredge on the Cosumnes River 7 miles northwest of Plymouth during 1941. The Pacific Placers Engineering Co. operated a dragline dredge with an electric dragline excavator, which used a 2½-cubic yard bucket, on the McCulloh property from January 1 to February 8 and from May 13 to December 31; 350,000 cubic yards of gravel yielded 2,749 ounces of gold and 258 ounces of silver. The Rim Cam Gold Dredging Co. operated a dragline dredge on the Yager ranch from February 4 to May 26.

Mother Lode district.—The Argonaut Mining Co., Ltd., operated the Argonaut mine throughout 1941; gold ore was treated by amalgama-

tion and flotation. During the year the company installed a 10-ton cyanide plant to handle concentrates from the Argonaut mine and the nearby Plymouth property, where it had treated old tailings by flotation; until this cyanide plant was put into operation, the concentrates were shipped to a smelter. The Central Eureka Mining Co. operated the Central Eureka and Old Eureka mines; the ore was treated by amalgamation and flotation, and the sands and concentrates were cyanided. The Black Hills Mining Co. worked the Italian mine. The Kennedy Mining & Milling Co. operated the Kennedy mine throughout 1941; gold ore was treated by amalgamation and flotation, and the concentrates were shipped to a smelter. The Keystone Mine Syndicate worked the Keystone mine; 97,945 tons of ore were treated in the company 300-ton amalgamation-flotation mill; 1,984 ounces of gold were recovered in bullion, and 9,226 ounces were contained in 747 tons of concentrates shipped to a smelter. The Delta Tailings Co. continued to cyanide material derived from old tailings collected in the channel of one of the streams draining a section of the Mother Lode district; two such deposits were worked during 1941. Henry & Weaver operated a dragline dredge, equipped with a dragline excavator and a ¾-cubic yard bucket, on the Allen ranch on Sutter Creek Gulch from November 22 until December 12. On Little Indian Creek 4 miles west of Plymouth W. D. Ingram operated a dragline dredge, which had two dragline excavators—one with a 2½-cubic yard and the other with a 1-cubic yard bucket -from January 1 to May 11; the tailings were leveled and the overburden replaced, fitting the land for further agricultural use. The Mountain Gold Dredging Co. operated a dragline dredge with a dragline excavator, using a 1½-cubic yard bucket, on the Matulich property in the Drytown section of the Mother Lode intermittently during 1941. W. D. Ingram and the Mountain Gold Dredging Co. operated dragline dredges on the W. F. Detert estate also during 1941. J. C. Pantle operated a dry-land dredge on the Rupley ranch on Willow Creek; 360,000 cubic yards of gravel yielded 1,850 ounces of gold and 254 ounces of silver. E. L. Lilly operated a dragline dredge, which employed a dragline excavator with a 2¼-cubic yard bucket, on the Treble Clef mine from January 1 to June 14 and from July 2 to December 16.

BUTTE COUNTY

Butte Creek district.—The Lancha Plana Gold Dredging Co. moved its connected-bucket dredge from Amador County to Butte County and resumed operations October 22, 1941. The Piedmont Dredging Co. operated a Becker-Hopkins type dredge on Butte Creek intermittently from September 24 until the end of the year; 29,592 cubic yards of gravel yielded 121 ounces of gold and 10 ounces of silver.

Magalia district.—S. F. Thomas operated the S & D mine from January 1 to September 1, 1941, when work was suspended; 529 tons of ore yielded 157 ounces of gold and 45 ounces of silver.

Oroville district.—Yuba Consolidated Gold Fields (Butte Unit) operated four electric connected-bucket dredges in the Oroville district during 1941; the dredge-bucket equipment per boat was as follows: Eighty-four 9-cubic foot, eighty-nine 9-cubic foot, eighty-seven 9-cubic foot, and seventy-one 6-cubic foot buckets. The Sunmar Dredging Co. operated a dragline dredge, which used a dragline

excavator with a 1½-cubic yard bucket, on the Clark, Cratt and Schwartz, Crowder and Binney, Darby, Darby and Crowder, Leal, and Schwartz and Pedrazzini properties. The Placer Exploration Co. operated two dragline dredges—one employed a dragline excavator with a 5-cubic yard bucket and the other a dragline excavator with a 2½-cubic yard bucket—on several properties in the district, including the Dagorret, California Lands, Inc., and Innis. The Golden Feather Dredging Co. operated a dragline dredge, equipped with a dragline excavator and a 5-cubic yard bucket, on Feather River near Oroville during 1941. Kaufield and Danison worked the Ford property with a nonfloating washing plant to which gravel was delivered with a dragline excavator, using a 1-cubic yard bucket, from October 15 to December 31. Wm. Richter & Sons operated dragline dredges on the Belkriet, Bilkli, Freidel, Helen Whittier, Hume and Coleman, John Alm, Lorrie, Ray Angle, Rottinger, and Wyandotte properties. The Interstate Mines, Inc., and Placer Exploration Co. operated dragline dredges on the Gianella ranch. The Oroville Gold Dredging Co. operated a Yuba connected-bucket dredge, with seventy-two 8½-cubic foot buckets, on the Hazelbusch and T. M. Rogers tracts on Feather River 9 miles southwest of Oroville during 1941. The Lemroh Mining Co. operated a dragline dredge, using a dragline excavator with a 2½-cubic yard bucket; 504,848 cubic yards of gravel yielded 2,739 ounces of gold and 195 ounces of silver. The Lobicasa Co. and the Sunmar Dredging Co. operated dragline dredges on the Peters ranch during 1941. The Placer Development Co. operated a dragline dredge with a dragline excavator having a 2½-cubic yard bucket at Meadows 3 miles south of Oroville. The Gold Hill Dredging Co. operated an electric connected-bucket dredge with seventy-four 9-cubic foot buckets on the Wilton Kister ranch on the east side of Feather River 7 miles south of Oroville.

Yankee Hill district.—Hoefling Bros. worked the Surcease mine and operated the company new flotation-cyanidation mill throughout 1941; most of the resulting concentrates were cyanided. Piombo Bros. & Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on French Creek from January 1 to December 31.

CALAVERAS COUNTY

Camanche district.—The Gold Hill Dredging Co. operated its electric-connected bucket dredge on the Arlington and Osterman properties along the Mokelumne River from January 1 to May 21, 1941. For 6 months Cat Camp Placers operated a nonfloating washing plant to which gravel was delivered by carry-all; 100,000 cubic yards of gravel yielded 605 ounces of gold and 34 ounces of silver. The Lobicasa Co. operated a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on the City of Stockton reservoir site from July 1 to December 23, when the ground was worked out. Burson Mining Co. operated a dry-land dredge on the Foster ranch intermittently; 495 ounces of gold and 37 ounces of silver were recovered from 55,200 cubic yards of gravel. From January 1 to July 22 Mehrten Bros. operated a nonfloating washing plant to which gravel was delivered by carry-all; 146 ounces of gold and 15 ounces of silver were recovered from treatment of 16,200 cubic yards of gravel. From January 18 to March 25 the Midas Placer Co. operated a non-

floating washing plant on high-channel gravel at the Penn gold-copper-zinc lode property. E. A. Bacon operated a nonfloating washing plant, to which gravel was delivered by bulldozer and carry-all, at the Wallace mine during 1941.

Campo Seco district.—Glo-Bar Mines operated the Glo-Bar drift mine in 1941. The Ralford Mining Co. operated a dragline dredge, using a dragline excavator with a ⅞-cubic yard bucket, on the Wm. P. Hiatt ranch from February 1 to July 10; 25,000 cubic yards of gravel yielded 199 ounces of gold and 14 ounces of silver.

Copperopolis district.—The Jumbo Consolidated Mining Co. turned over the Mountain King mine to the El Gabilan Corporation during 1941; gold ore was treated by flotation, and the gold concentrates were shipped to a smelter.

East Belt district.—The St. Joseph Lead Co. worked the Sheepranch mine throughout 1941; the ore was treated in a 150-ton amalgamation-flotation mill, and the concentrates were shipped to a smelter. The Horseshoe Dredging Co. operated a dragline dredge on Jesus Maria Creek from July 25 to October 24.

Jenny Lind district.—F. S. Tower operated the Royal mine during 1941; the ore was treated in a 20-stamp mill that employed amalgamation, flotation, and vanner concentration. Thompson Dredge operated a dragline dredge having a dragline excavator with a 2½-cubic yard bucket on the Gregory, Sinclair, and Dickhaut ranches 1½ miles southwest of Jenny Lind from January 1 to April 20; later in the year the dredge was operated in Siskiyou County by the Shasta Dredging Co. C. F. Vanciel operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, at the Hatler mine 5 miles west of Jenny Lind on Calaveras River from February 20 to April 26; 552 ounces of gold and 27 ounces of silver were recovered from 87,848 cubic yards of gravel. G. T. Oien operated a nonfloating washing plant to which gravel was delivered by mechanical means. The Horseshoe Dredging Co. and the Stagan Mining Co. operated dragline dredges on the Robie property on Calaveras River 2 miles southwest of Jenny Lind during 1941. The Stagan Mining Co. also operated its dragline dredge on the Willits ranch from October 15 to December 31; the dragline excavator had a 1¾-cubic yard bucket. Henry & Weaver operated a dragline dredge, using a dragline excavator with a ¾-cubic yard bucket, on Neapolitan Gulch from July 23 to November 7. The Wolhall Dredging Corporation operated a dragline dredge which had a dragline excavator with a 2-cubic yard bucket near Jenny Lind intermittently in 1941.

Mother Lode district.—The Carson Hill Gold Mining Corporation treated 381,326 tons of gold ore at the Carson Hill mine during 1941 and produced amalgamation bullion containing 5,835 ounces of gold and 559 ounces of silver; cyanidation bullion containing 15,390 ounces of gold and 5,141 ounces of silver; and 48 tons of gravity concentrates which, after partial extraction by amalgamation, contained 1,046 ounces of gold, 1,473 ounces of silver, and 590 pounds of copper when delivered to a smelter. According to the company printed annual report for the year ended September 30, 1941, the average recovery was $2.15 per ton of ore compared with $2.19 for the year ended September 30, 1940. Operating costs (including 4,251 feet of development work and maintenance and improvement of plant) were reported as $1.94 per ton compared with $1.90 for the preceding

year. Because of the narrow-profit margin and rising costs, no ore-reserve figures were given. R. Hageman operated the Del A Ray mine from August 15 until the end of the year; 700 tons of ore were treated by amalgamation and concentration, and bullion, containing 200 ounces of gold and 40 ounces of silver, and 11 tons of concentrates, containing 3 ounces of gold, were produced. Le Roi Mines, Inc., worked the Easyz Bird mine and operated its 125-ton flotation mill from February 10 until the end of 1941; most of the gold was recovered by the smelting of concentrates. The Horseshoe Dredging Co. operated a dragline dredge on the Beers, Gertzen, and Osborn ranches. The San Andreas Gold Dredging Co., which was sold to Thurman & Wright March 7, 1941, operated two dragline dredges on the Fischer, Hageman-Huberty, Hageman, Lombardi, and Nuner properties; each dragline excavator had a 1½-cubic yard bucket. The Fire Protection Engineering Co. operated a nonfloating washing plant, to which gravel was delivered by mechanical means. Quartz Hill Placers and A. W. Ellis operated a stationary washing plant, to which gravel was delivered by a power shovel, on the Quartz Hill property; 11,270 cubic yards of gravel yielded 298 ounces of gold and 30 ounces of silver. The Imperial Dredging Co. operated a dragline dredge on the White property from April 1 to September 4.

ELDORADO COUNTY

East Belt district.—The Cosumnes Mines, Inc., treated gold ore from a group of claims in the Grizzly Flat section of the East Belt by amalgamation and concentration in 1941. The Eagle King Mining Co. worked the Eagle King mine; gold ore was treated in a 40-ton flotation mill, and the concentrates were shipped to the Empire Star mill in Grass Valley for cyanidation. The Greenhorn Dredging Co. operated a dragline dredge on the Barkley property near Youngs. W. D. Ingram operated a dragline dredge at Horseshoe Bar on American River from October 7 to December 31; dredging was conducted also in Placer County part of the year, as the river passes through the property and the center of the river is the county line.

Mother Lode district.—The Alhambra-Shumway Mines, Inc., worked the Alhambra mine from January 1 to June 1, 1941; 1,983 tons of ore treated by amalgamation and flotation yielded bullion, containing 799 ounces of gold and 111 ounces of silver, and 17 tons of concentrates containing 123 ounces of gold and 19 ounces of silver. The Madre de Oro Gold Mines, Inc., reopened the Church mine and treated 496 tons of ore in a 3-stamp mill; gold bullion containing 149 ounces of gold and 35 ounces of silver was recovered by amalgamation, and 5 tons of concentrates containing 20 ounces of gold and 5 ounces of silver were recovered by flotation; the company constructed a 20-stamp mill. The California Aztec Mining Co. operated its Kelsey Unit from January 1 to September 24 and treated ore by amalgamation and flotation in a 50-ton mill. The Middle Fork Gold Mining Co. operated the Sliger mine and treated the ore in a 160-ton amalgamation-flotation mill; during 1941 a new changehouse was completed at the property. This company's recent development of a method [1] using tailings for stope filling has proved very successful.

[1] Plumb, C. W., Filling Mine Stopes with Mill Tailings: Min. Cong. Jour., vol. 28, No. 1, January 1942, pp. 12-14.

The El Dorado Dredging Corporation operated a dragline dredge using a dragline excavator with a 1½-cubic yard bucket on Coloma Creek 2 miles south of Greenwood from January 1 to March 6; 833 ounces of gold and 124 ounces of silver were recovered from 106,078 cubic yards of gravel. This company moved its equipment to the Hughes property on Rock Canyon Creek and handled 338,940 yards of gravel, from which 2,630 ounces of gold and 281 ounces of silver were recovered between March 17 and October 28; at the end of the year the dredge operated on Irish Creek. W. D. Ingram operated dragline-dredging equipment on the Craig Osborne, Craig Royce, Craig Salt Water, Emma J. Hodgkin, and Red Raven properties. The General Dredging Corporation operated a dragline dredge with a dragline excavator, using a 2-cubic yard bucket, on ground adjacent to American River near Coloma from January 1 to August 30; the company operated a second dragline dredge, equipped with a dragline excavator having a 1½-cubic yard bucket, in the same area from January 1 to September 30. Van Dyke, Modrell, and Warner operated a dragline dredge, using a dragline excavator with a ¾-cubic yard bucket, on the Emma Gordon property from May 17 to September 10. The Orolomo Co. operated a dry-land dredge, which had a dragline excavator with a 1½-cubic yard bucket, on Indian Creek throughout 1941. The River Pine Mining Co. operated its dragline dredge on the North Fork of Cosumnes River near Nashville between July 8 and December 15; this dredge worked in the East Belt district, Amador County, the first half of the year.

West Belt district.—The General Dredging Corporation moved its smaller dragline dredge from Coloma to a site near Shingle Springs; operations were resumed October 1 and continued until the end of 1941. The Big Canyon Dredge operated a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on Deer Creek for 11 months; 3,160 ounces of gold and 321 ounces of silver were recovered from 540,000 cubic yards of gravel.

FRESNO COUNTY

Friant district.—Griffith Co. and Bent Co., which supplied gravel for the Friant Dam in 1941, recovered 4,990 ounces of gold and 747 ounces of silver in preparing 3,935,620 tons of sand and gravel. Hopkins & Becker operated a suction dredge invented by Becker on the San Joaquin River near the town of Friant; 298 ounces of gold and 61 ounces of silver were recovered from 121,000 cubic yards of gravel. The dredge had a 6-inch centrifugal gravel pump, gasoline engine, and riffle tables mounted on a steel pontoon hull; the suction point could be lowered vertically 28 feet below water level.

HUMBOLDT COUNTY

Orleans district.—Hydraulicking at the Pearch mine yielded 266 ounces of gold and 38 ounces of silver from 128,500 cubic yards of gravel in 1941.

IMPERIAL COUNTY

Cargo Muchacho district.—The Holmes & Nicholson Mining & Milling Co. shipped substantial quantities of gold ore from the Cargo Muchacho group of claims and the Gold Bird mine to the company

100-ton all-slime-cyanidation mill 4 miles west of Winterhaven in 1941.

Mesquite Diggings district.—The Reese Production Corporation operated an open pit on the property leased from the Desert Gold & Aluminum Co. from March 22 to November 8, 1941; the ore, which was treated by amalgamation, resembled cemented gravel.

INYO COUNTY

Bishop Creek district.—The United States Vanadium Corporation produced a copper concentrate containing a substantial quantity of silver as a byproduct of ore treated primarily for tungsten in 1941.

Chloride Cliff district.—Lessees shipped gold ore from the Old Mill schist mine to a custom cyanide plant in 1941.

Modoc district.—From the Colorado mine E. H. Snyder and associates shipped 416 tons of zinc carbonate ore, containing 327,058 pounds of zinc, to a zinc oxide plant in the San Francisco Bay region and 336 tons of ore to the Combined Metals Reduction Co. flotation plant at Stockton, Utah, during 1941; the zinc concentrates from the material treated at Stockton contained 2 ounces of gold, 529 ounces of silver, 6,715 pounds of copper, and 185,475 pounds of zinc. This property, though still in the prospecting stage, was the largest zinc producer in California during the year.

Resting Springs district.—Shoshone Mines, Inc., shipped ore from the Columbia No. 2 mine throughout 1941 and was by far the largest producer of lead and the sixth-largest producer of silver in the State.

Sherman district.—A substantial quantity of gold was recovered by cyanidation of ore mined by the Arondo Mining Co. at the Arondo mine during 1941. Burton Bros., Inc., operated the Ruth mine and treated 21,181 tons of ore by crushing and cyanide-leaching; 5,587 ounces of gold and 105 ounces of silver were recovered.

South Park district.—Lessees on the Cecil R. mine shipped gold ore to a custom cyanide plant in 1941. Mining Associates shipped gold ore from the Gold Bug mine to custom mills. Several lessees worked the Mint-O-Gold mine and shipped a total of 593 tons of ore to custom cyanide mills; 515 ounces of gold and 25 ounces of silver were recovered. The Old Gold Mines Co. shipped lead ore containing substantial quantities of gold and silver from the Old Gold mine.

Union district.—Lessees on the Reward (Brown Monster) mine shipped 451 tons of ore containing 260 ounces of gold and 1,639 ounces of silver to a custom cyanide plant in 1941.

Wild Rose district.—The Del Norte Mining Co. treated gold ore by cyanidation and concentration at the Del Norte-Skidoo group in the Skidoo section of the Wild Rose district during 1941. L. Warnken cyanided ore at the Tucki mine.

KERN COUNTY

Amalie (Agua Caliente) district.—Lessees operated the Aunt Rosa mine and treated ore by amalgamation and concentration during 1941.

Cove district.—Kern Mines, Inc., operated the Big Blue mine throughout 1941; 43,914 tons of ore yielded amalgamation bullion containing 2,909 ounces of gold and 1,218 ounces of silver and 728 tons of flotation concentrates containing 3,130 ounces of gold, 9,142

ounces of silver, 578 pounds of copper, and 19,748 pounds of lead; the concentrates were shipped to a smelter.

Green Mountain district.—Geringer Bros. operated the Gwynne mine from April 15 to December 10, 1941; gold ore was shipped to a custom cyanide plant. The Lone Star Mining Co. worked the Lone Star mine; most of the ore was treated in the company 10-stamp mill, but a small quantity was shipped to a custom cyanide plant.

Mojave district.—The Cactus Mines Co. operated the Cactus Queen mine in the Middle Butte section of the Mojave district throughout 1941 and treated gold-silver ore in the company 125-ton cyanidation-flotation mill; the resulting concentrates were shipped to a smelter. In 1941, for the fourth year, this property was the State's leading silver producer. The Golden Queen Mining Co. operated the Golden Queen mine the entire year; in addition to treating a large tonnage of company ore in its 425-ton cyanide mill, it did a substantial custom-mill business. The Lodestar Mining Co. and lessees shipped 50,613 tons of gold-silver ore containing 9,177 ounces of gold and 180,875 ounces of silver to custom cyanide mills; mining operations were suspended September 13, the property, machinery, and equipment were sold to the Golden Queen Mining Co., and the corporation was completely liquidated November 30, 1941. The Standard Hill Mines Co. and numerous lessees shipped 7,381 tons of ore from the Standard Hill mine to custom cyanide mills; 2,726 ounces of gold and 33,136 ounces of silver were recovered. Burton Bros., Inc., operated the Tropico mine both on company account and through lessees; 35,494 tons of gold ore treated in the company 150-ton cyanide plant yielded 8,042 ounces of gold and 13,444 ounces of silver. In addition, the company treated over 8,800 tons of custom material from 215 shippers during 1941. As a pioneer in California custom milling east of the Sierra Nevada Mountains, Burton Bros., Inc., has been an important factor in the development of mineral resources within a radius of 100 miles or more of Rosamond, where the company mill is located. Lessees on the Whitmore mine shipped 790 tons of gold-silver ore to custom cyanide mills; 310 ounces of gold and 5,296 ounces of silver were recovered.

Randsburg district.—The Butte Lode Mining Co. operated the Big Butte mine throughout 1941; 727 tons of ore treated by amalgamation yielded 262 ounces of gold and 91 ounces of silver, and current sands from this operation, plus 490 tons of old tailings, yielded 10 ounces of gold and 3 ounces of silver by cyanide leaching. Several groups of lessees worked the Big Dyke mine and shipped 903 tons of ore to custom cyanide plants, which recovered 356 ounces of gold and 37 ounces of silver. J. M. Kreta operated the Big Gold group; the custom cyanide plant to which the ore was shipped recovered gold and silver. Lessees on the Buckboard mine produced 1,563 tons of gold ore during 1941; 970 tons treated by amalgamation at the Baltic mill yielded 228 ounces of gold and 46 ounces of silver, and 593 tons of ore shipped to a custom cyanide plant yielded 182 ounces of gold. Lessees shipped gold ore from the K. C. N. mine to custom cyanide plants. The King Solomon Mines Lease and other lessees worked the King Solomon mine during 1941; 1,915 tons of ore and 1,972 tons of old tailings were treated in a 5-stamp mill and cyanide-leaching plant; the amalgamation bullion contained 852 ounces of gold and 247 ounces of silver, and the cyanidation bullion contained 77 ounces of

gold and 19 ounces of silver; 3 tons of concentrates shipped to a smelter yielded 7 ounces of gold and 35 ounces of silver. Shipments, totaling 674 tons, of gold ore from the Wade mine to a custom cyanide mill yielded 479 ounces of gold. The Anglo American Mining Corporation, Ltd.—largest operator in the Randsburg district—treated 454,583 tons of old tailings and recovered 7,731 ounces of gold and 3,245 ounces of silver during 1941. The old tailings were treated by slime-agitation and sand-leaching in a 1,400-ton cyanide plant; 237,976 pounds of "Aero" brand calcium cyanide were consumed.

LOS ANGELES COUNTY

Cedar district.—The Governor Mine Co., operator of the Governor mine, was the principal producer in the Cedar district during 1941; operations were suspended late in the year.

Neenach district.—A substantial quantity of gold ore was shipped from the Big Susanna mine to a custom cyanide mill during 1941.

MADERA COUNTY

Dennis district.—Two suction dredges were operated in 1941 on Fresno River where it passes through the Cassaurang ranch. H. A. Berg also operated a suction dredge on Fresno River; 22,000 cubic yards of gravel yielded 257 ounces of gold and 74 ounces of silver.

MARIPOSA COUNTY

East Belt district.—The Diltz mine was worked during 1941. The Black Oak Mining Co. operated the Feliciana mine; 716 tons of ore treated by amalgamation and flotation yielded bullion containing 228 ounces of gold and 36 ounces of silver and 6 tons of concentrates containing 59 ounces of gold and 11 ounces of silver; the concentrates were shipped to a smelter. A 25-ton amalgamation-flotation mill was constructed on the Feliciana property and put into operation November 1, 1941.

Hunter Valley district.—The Pacific Mining Co. reopened the Washington and Jenny Lind lode claims in 1941 and put a newly constructed 125-ton flotation mill into operation in July; a substantial quantity of ore was treated, and the resulting concentrates were shipped to a smelter. The Pacific Mining Co placed the operation under a corporation—Lind Mining Co. September 1. The Mount Gaines Mining Co. worked the Mount Gaines mine. Thurman & Wright operated a dragline dredge, equipped with a dragline excavator having a 6-cubic yard bucket, on the Crocker-Huffman Land & Water Co. property from June 17 until the end of 1941. The Barker Corporation operated a dragline dredge on Eldorado Creek and on several other properties, including the Givens, Trabucco, Turner, and Waltz. The Trebor Corporation also carried on dragline dredging on several properties, including the Fretz, Gaskill, Machado, Trabucco, Turner, and Waltz.

Mother Lode district.—The Granite King mine was worked in 1941. The Boston California Mining Co. operated the Malvina group. The Pacific Mining Co. worked the Pine Tree and Josephine mines during the year and treated 58,151 tons of ore by amalgamation and

flotation; the amalgamation bullion contained 1,465 ounces of gold and 313 ounces of silver, and the flotation concentrates shipped to a smelter contained 7,507 ounces of gold, 1,802 ounces of silver, and 2,770 pounds of copper. This company also produced a small quantity of gold at the Evans and French properties. Golden Quail, Inc., treated 4,200 tons of ore from the Quail mine in a 50-ton amalgamation-flotation mill; amalgamation bullion contained 57 ounces of gold and 10 ounces of silver, and 49 tons of concentrates shipped to a smelter contained 217 ounces of gold, 151 ounces of silver, and 103 pounds of copper. The Golden Quail, Inc., lease was returned to the Quail Mining Co. in December, 1941. The Barker Corporation did dragline dredging on the Adams, Explorers, Inc., Munn, Penrose, R. Williams, and Stratton properties.

MERCED COUNTY

Hunter Valley district.—The Thurman & Wright dragline-dredge operations on the Crocker-Huffman Land & Water Co. and Waltz properties extended from Mariposa County into Merced County during part of 1941.

Snelling district.—The Merced Dredging Co. operated an electric connected-bucket dredge, with sixty-two 10-cubic foot buckets, one-half mile southeast of Snelling. The electric connected-bucket dredge of Yuba Consolidated Gold Fields (Merced Unit), equipped with seventy-two 9-cubic foot buckets, completely worked out its property 4 miles east of Snelling by the end of 1941. The San Joaquin Mining Co. operated a connected-bucket dredge, with sixty-four 10 cubic foot buckets, 2½ miles southwest of Snelling. The Snelling Gold Dredging Co. operated two connected-bucket dredges on Merced River between Snelling and Merced Falls throughout 1941; one of the dredges was equipped with sixty-six and the other with seventy-two 7-cubic foot buckets.

MONO COUNTY

Blind Springs district.—The Mineral Reduction Co. continued to operate its custom cyanide-flotation mill throughout 1941; 65 shippers sent the plant over 1,400 tons of ore during the year. The decline in precious-metal mining in the area tributary to the mill resulted in plans being made to convert it to producing other concentrates.

Bodie district.—The Roseklip Mines Co. cyanided ore from dumps and open-cuts at the Standard mine in a 400-ton cyanide plant during 1941.

Chidago district.—R. G. Jones operated the Gold Crown mine from January 1 to August 16, 1941; the lease was relinquished August 29, and operations were continued by the owner until the end of the year. The ore was shipped to a custom cyanide mill.

Homer (May Lundy) district.—The Log Cabin Mines Co. operated the Log Cabin (Simpson) mine from January 1 to November 1, 1941; 17,855 tons of ore treated in a 100-ton amalgamation mill yielded 3,287 ounces of gold and 907 ounces of silver.

Mammoth Lakes district.—The Monte Christo Mining Co. operated the Monte Christo group from May 1 to November 1, 1941; a 30-ton flotation mill was built during the year.

NAPA COUNTY

Calistoga district.—The Grigsby (Palisade) mine, worked by the Graham Loftus Oil Corporation in 1940, was operated from January 1 to August 16, 1941, by Helena Consolidated Mines, Inc.; 6,599 tons of gold-silver ore were treated in a 100-ton flotation mill, and 116 tons of resulting gold-silver concentrates containing 350 ounces of gold, 36,121 ounces of silver, and 4,009 pounds of copper were shipped to a smelter. The company reported that the mine was closed August 16, the equipment and buildings had been removed from the property, and no further operations were contemplated.

NEVADA COUNTY

Grass Valley-Nevada City district.—A. Louiselli operated the Black Prince mine during 1941. Grass Valley Bullion Mines, Inc., shipped ore to the Idaho Maryland Mines Corporation mill from January 1 to April 30, after which operations were greatly curtailed. The Empire Star Mines Co., Ltd., operated the Empire, North Star, and Pennsylvania mines at Grass Valley, and the Pennsylvania and Dannebrog at Browns Valley in Yuba County; some work was also carried on at the Zeibright mine in Bear Valley and at the Murchie mine at Nevada City. Late in 1941 work was begun on a drainage, exploration, and tailings-disposal adit from the South Fork of Yuba River near Omega to the lower workings of the Zeibright mine, a distance of over 3 miles. Failure of the extensive exploration campaign in the Murchie mine to reveal substantial quantities of ore resulted in the suspension of all work at the property late in the year. Cooley Butler operated the Golden Center mine. The Idaho Maryland Mines Corporation operated the Idaho Maryland-Brunswick group. According to the company printed annual report for the year ended December 31, 1941, 113,973 ounces of gold and 30,000 ounces of silver were recovered from 263,768 tons of ore, compared with a recovery of 129,309 ounces of gold from 406,707 tons of ore in 1940. Although these figures represent an 11-percent decline in quantity of gold produced, they show a 36-percent gain in grade of ore mined. In 1941, 48,803 tons of ore were derived from development headings, and 214,965 tons were produced by stoping. In addition to company ore, 8,586 tons of custom ore and 348 tons of custom concentrates were treated. Dividends declared and paid in 1941 totaled $1,074,-020.80, raising total disbursements in dividends to $6,797,986.40. The annual report attributes the decline in production in 1941 in part to a 19-day labor strike in May, after which the company had difficulty in rebuilding and maintaining a complete labor force owing to competition from war industries. In addition, unanticipated delays in erecting a new headframe at the New Brunswick shaft, due to a shortage of steel erectors, contributed to the reduction in ore production. The Idaho Maryland-Brunswick operation continued to hold first place among California mines as a gold producer, and the Idaho Maryland Mines Corporation was second to Yuba Consolidated Gold Fields among California gold-producing companies. The Lava Cap Gold Mining Corporation operated the Lava Cap mine throughout the year; 146,900 tons of ore were treated by amalgamation, flotation, and cyanidation in the company 400-ton flotation plant, 25-ton concentrate- and middling-cyanide plant, and 350-ton tailings-cyanide

plant. Cyanidation of sand, slimes, and 4,762 tons of concentrates yielded 1,729 ounces of gold and 19,596 ounces of silver; amalgamation of high-grade ore yielded 318 ounces of gold and 78 ounces of silver; 1,010 tons of flotation concentrates shipped to a smelter contained 36,796 ounces of gold, 324,162 ounces of silver, 38,367 pounds of copper, and 10,737 pounds of lead. Operators of the Queen Lil mine treated 312 tons of ore by amalgamation and recovered 249 ounces of gold and 41 ounces of silver. The Spring Hill Gold Mines, Inc., operated the Spring Hill mine throughout 1941; ore was treated in the company 100-ton flotation plant, and the resulting concentrates were treated by amalgamation and cyanidation. The Stockton Hill Corporation worked the Stockton Hill mine. William Richter & Sons operated a dragline dredge on the Donnelly and Johnson property during 1941. The M. K. Gibson Mining Co. operated a dragline dredge on the Elder, Martel, Neirzert, and Thomas properties. The Wyandotte Dredging Co. operated a dragline dredge with a dragline excavator having a 2½-cubic yard bucket on the Perrin and Pingree properties during 1941; 130,000 cubic yards of gravel treated on the Perrin property yielded 1,186 ounces of gold and 155 ounces of silver, and 70,000 cubic yards washed at the Pingree property yielded 339 ounces of gold and 58 ounces of silver.

North Bloomfield district.—Kaufield & Danison operated a dragline dredge on Columbia Hill from March 1 to April 20, 1941. A B. Innis operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, at the Malakoff mine from October 16 to December 31; 72,000 cubic yards of gravel yielded 333 ounces of gold and 33 ounces of silver. Western Gold, Inc., carried on hydraulicking operations at Relief Hill.

Washington district.—The Omega Co. began hydraulicking March 9, 1941, at the Omega mine upon completion of the Upper Narrows Debris Dam at Smartville and continued operations until July 7; the company washed 429,637 cubic yards of gravel, which yielded 1,302 ounces of gold and 49 ounces of silver. This was the first major operation to take advantage of the debris storage back of the new dam.

ORANGE COUNTY

Santa Rosa district.—The Blue Light Silver Mines, Inc., worked the Silverado or Blue Light mine in Silverado Canyon throughout 1941; the gross content of the concentrates from 403 tons of ore treated by flotation was 18 ounces of gold, 4,846 ounces of silver, 1,300 pounds of copper, 14,383 pounds of lead, and 43,839 pounds of zinc.

PLACER COUNTY

Dutch Flat district.—The Canyon Mines Corporation suspended operations at the Rawhide mine during 1941. La Kamp Bros. operated a nonfloating washing plant at the Mutual mine, to which gravel was delivered with a bulldozer.

Foresthill district.—The Volcano Mining Co., Ltd., worked the Volcano drift mine throughout 1941; 4,000 tons of gravel yielded 206 ounces of gold and 27 ounces of silver.

Iowa Hill district.—The Lebanon Consolidated Mines worked the Occidental drift mine from January 1 until December 31; 3,766 cubic yards of gravel yielded 536 ounces of gold and 63 ounces of silver.

Lincoln district.—A nonfloating washing plant to which gravel was delivered by mechanical means operated on the Guilford ranch during 1941. On the Johnson ranch, C. N. Chittenden operated a nonfloating washing plant to which gravel was delivered by a dragline excavator with a ¾-cubic yard bucket; 43,500 cubic yards of gravel yielded 282 ounces of gold and 51 ounces of silver.

Michigan Bluff district.—The W. D. Ingram dragline-dredge operation on Horseshoe Bar on the Eldorado County line treated some gravel in Placer County.

Ophir district.—The Alabama California Gold Mines Co. operated the Alabama mine throughout 1941; the ore was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter; amalgamation bullion contained 14,566 ounces of gold and 4,581 ounces of silver, and 797 tons of concentrates contained 3,527 ounces of gold, 44,862 ounces of silver, 12,045 pounds of copper, and 46,591 pounds of lead. J. K. Wright and L. W. Smith worked the Duncan Hill mine from April 15 to December 31; 200 tons of ore yielded 207 ounces of gold and 85 ounces of silver by amalgamation. Highway Forty Mines, Inc., operated the Highway Forty mine during 1941. V. J. DeCampos worked the Mary Len mine; 1,838 tons of ore treated by amalgamation and flotation yielded 509 ounces of gold and 244 ounces of silver, and 20 tons of concentrates, treated at a custom cyanide plant, yielded 96 ounces of gold and 90 ounces of silver. Oro Fino Consolidated Mines operated the Oro Fino mine during 1941; the ore was treated in an amalgamation-flotation mill, and the resulting concentrates were shipped to a custom cyanide plant and to a smelter. From March to October, on the Ferrari property, the Panob Gold Dredging Co. operated a nonfloating washing plant, with Ainlay bowls, to which gravel was delivered by a dragline excavator with a 1½-cubic yard bucket; the same company operated similar equipment on the Forsyth & Lewis property. H. W. McKinley operated a dragline dredge on the Fisher ranch from June 17 to July 31. Gold Placers, Inc., operated a dragline dredge on the Robinson ranch from April 30 to August 30 and on the Leak ranch from September 7 to December 20. Hallstrom and Lindblad operated during 1941 a nonfloating washing plant, to which gravel was delivered by mechanical means, on the Joseph Mooney, Mathilda Bahr, and Rogers ranches and in Miners Ravine. The Roseville Gold Dredging Co. operated a connected-bucket dredge, with seventy-two 3-cubic foot buckets, in Strap Ravine 6 miles east of Roseville. The Gold Recoveries Corporation operated a dragline dredge on the William Ayers and Anderson properties.

PLUMAS COUNTY

Genesee district.—The Walker Mining Co. (affiliate of the Anaconda Copper Mining Co.) suspended operations October 31, 1941, at its Walker mine, the outstanding mine in Plumas County and California's largest copper producer for several years. According to the company printed annual report for the year ended December 31, 1941, 291,438 tons of ore were milled and 14,387 tons of concentrates produced. Shipments comprised 14,929 tons of concentrates, lime scale, and precipitates, with a net recoverable content of 7,248,128 pounds of copper, 10,938 ounces of gold, and 166,581 ounces of silver. The

company report states that, despite a vigorous exploration campaign for more than 2 years, ore developments had been unfavorable and the operation remained unprofitable under the prevailing prices for copper.

Greenville (Crescent Mills) district.—Cherokee Mine operated the Cherokee mine throughout 1941; 26,344 tons of ore were treated in the company 150-ton cyanidation-flotation mill, and 127 tons of resulting concentrates were shipped to a custom cyanide plant. In all, 5,627 ounces of gold and 1,726 ounces of silver were recovered.

Johnsville district.—In 1941 lessees and sublessees on the Jamison mine treated 489 tons of ore and 401 tons of old tailings by amalgamation and concentration and shipped 112 tons of ore and 3 tons of concentrates to a smelter; amalgamation bullion contained 103 ounces of gold and 13 ounces of silver; ore smelted contained 144 ounces of gold and 38 ounces of silver; and concentrates smelted contained 11 ounces of gold and 3 ounces of silver. The Lobicasa Co. operated a dragline dredge on Jamison Creek from August 20 to December 24.

Lights Canyon district.—A. B. Innis operated a dragline dredge, equipped with a dragline excavator having a 1½-cubic yard bucket, on Lights Creek from January 1 to September 22, 1941; 1,653 ounces of gold and 130 ounces of silver were recovered from 250,000 cubic yards of gravel.

Quincy district.—Baker and McCowan operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, in Meadow Valley during 1941.

Rich Bar district.—The Virgilia Mining Corporation operated the Ohio Point mine during 1941; the ore was treated in the company 240-ton flotation mill, and the concentrates were shipped to a smelter.

RIVERSIDE COUNTY

Dale district.—D. M. Campbell and sublessees shipped 344 tons of ore from the Los Angeles mine to a custom cyanide plant in 1941; 257 ounces of gold and 3 ounces of silver were recovered. Gold ore from the Mission mine was shipped to the Gold Crown custom cyanide plant.

Eagle Mountain district.—Imperial Metals, Inc., suspended operations at the Black Eagle mine early in 1941; substantial shipments of argentiferous lead ore were made to a smelter.

SACRAMENTO COUNTY

Cosumnes River district.—Hoosier Gulch Placers operated boat No. 1 on the Biggs ranch and boat No. 2 on the Rossi property throughout 1941. Cosumnes Gold Dredging Co. operated an electric connected-bucket dredge with sixty-three 12-cubic foot buckets 7 miles southwest of Sloughhouse. McQueen & Downing operated a dragline dredge on Deer Creek from January 1 to February 14. The Humphreys Gold Corporation operated a nonfloating washing plant, which was converted to a dragline dredge, on the Fassett-Parker-Hanlon and Hutchinson properties. F. O. Bohnett also operated on the Hutchinson property. At the end of 1941 the Humphreys Gold Corporation equipment consisted of five dragline excavators, each with a 2½-cubic yard bucket—three for stripping and two for delivering gravel to two washing plants. An average of 18 feet of over-

burden was side-cast, and 12 feet of gravel and 1 foot of bedrock were washed. The Lobicasa Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on the Mahon property from June 5 to October 17 when the property was worked out.

Folsom district.—The Capital Dredging Co. operated two electric connected-bucket dredges on its property 5 miles south of Folsom during 1941; one dredge had 88 and the other 100 18-cubic foot buckets. The General Dredging Corporation—dissolved September 30, 1941, and continued as General Dredging Co., a partnership—operated its dragline dredge No. 1, equipped with a dragline excavator having a 5-cubic yard bucket, at its property on American River. Its No. 2 dredge, operating on the ancient river channel in the same district, used a dragline excavator with a 2-cubic yard bucket; dredge No. 4, working gravel along American River, near Fair Oaks, likewise used a dragline excavator with a 2-cubic yard bucket. The Climax Dredging Co. operated a dragline dredge on the J. Vincent property from January 1 to April 8. The Lancha Plana Gold Dredging Co. operated a Yuba electric dredge with 84 6-cubic foot buckets at Sailor's Bar on American River throughout 1941. The Natomas Co. fleet of seven electric connected-bucket dredges produced more placer gold than any other operation in the State in 1941. The number and size of buckets per dredge were: No. 1, 62 16-cubic foot buckets; No. 4, 67 15-cubic foot; No. 5, 105 12-cubic foot; No. 6, 106 11-cubic foot; No. 7, 98 9-cubic foot; No. 8, 105 12-cubic foot; and No. 10, 83 15-cubic foot buckets. The Carson Creek Dredging Co., Ltd., worked a dragline dredge on the Quinn ranch from January 1 until February 5, when the operation was taken over by the Northwest Development Co.

SAN BERNARDINO COUNTY

Black Hawk district.—A small quantity of gold ore was shipped to custom mills from the Santa Fe (Arlington) mine during 1941; the Beverly Oil Co. foreclosed and acquired title to the property November 21.

Buckeye district.—F. W. Royer shipped gold ore from the Bagdad Chase-Roosevelt group to a smelter during 1941.

Calico district.—Operators of cyanide-leaching plants on Calico tailings were the principal producers in the Calico district in 1941.

Dale district.—The Gold Crown Mining Co., Ltd., worked the Gold Crown mine throughout 1941; in addition to treating company ore, the mill handled over 2,400 tons of custom material from 24 shippers in its 50-ton all-slime cyanide plant. L. A. Wilson shipped 865 tons of ore to a custom cyanide plant; 709 ounces of gold were recovered.

Hart district.—W. W. Hartman operated the Valley View mine from January 1 to August 2, 1941; a substantial quantity of gold ore was treated in the company 40-ton cyanide plant; the mill was used late in the year to test ores trucked from a mine in the Ivanpah Mountains.

Holcomb Valley district.—The Big Bear Mines, Ltd., Inc., operated the Big Bear (Lucky Baldwin) mine from September 5, 1941, until the end of the year; a 150-ton amalgamation-flotation mill was built at the property. The Holcomb Valley Placer Co. operated a non-

floating washing plant, to which gravel was delivered by tractor and scraper, from July 7 to November 16; 16,265 cubic yards of gravel yielded 204 ounces of gold and 10 ounces of silver.

Ivanpah district.—W. F. Houston operated the Carbonate King mine from January 7 to December 31, 1941; 547 tons of ore shipped to a zinc smelter and a zinc oxide plant contained 446,786 pounds of zinc and 1,136 pounds of lead. This operation was the second-largest in zinc output in the State.

Randsburg district.—F. W. Royer operated the Kelly mine largely through lessees during 1941; in addition to Kelly ore, a custom cyanide plant at the mine treated over 6,200 tons of ore from approximately 66 shippers during the year.

SAN DIEGO COUNTY

Pine Valley district.—Long Valley Mining & Milling Association operated the Eagle Nest mine throughout 1941; 767 tons of ore treated by amalgamation and flotation yielded amalgamation bullion containing 73 ounces of gold and 8 ounces of silver, and 8 tons of concentrates shipped to a smelter contained 110 ounces of gold and 14 ounces of silver. During the year construction of a 75-ton amalgamation-concentration mill was begun. This property and several others in the district are recent discoveries.

SAN JOAQUIN COUNTY

Camanche district.—The Gold Hill Dredging Co. operated two electric connected-bucket dredges on the Jennie Lucas, Alex Perie, Putnam, Thorne, and Osterman properties during 1941; one dredge had sixty-six 7¾-cubic foot buckets and the other eighty-seven 8½-cubic foot buckets.

Jenny Lind (Bellota, Linden) district.—The California Gold Dredging Co. operated an electric connected-bucket dredge with eighty-one 6-cubic foot buckets from January 1 to December 11, 1941. The Smith-Notterman Co. operated a dragline dredge, using a dragline excavator with a 1¾-cubic yard bucket, on the Elmer Cady and Lewallen ranches. A. G. Watkins & Sons operated a dragline dredge, equipped with a dragline excavator having a 2-cubic yard bucket, intermittently during 1941 on Calaveras River.

SHASTA COUNTY

Flat Creek (Iron Mountain) district.—The Mountain Copper Co., Ltd., largest mineral producer in Shasta County, worked the Iron Mountain mine throughout 1941. Most of the ore was mined by the open-cut method and was cyanided in a 500-ton sand-leaching plant and 200-ton flotation-countercurrent-decantation plant; in addition, a small shipment of copper ore was made to a smelter.

French Gulch district.—Operators of the Brunswick mine treated 2,009 tons of ore by amalgamation and flotation; amalgamation bullion contained 186 ounces of gold and 28 ounces of silver, and 38 tons of resulting concentrates shipped to a smelter contained 79 ounces of gold and 9 ounces of silver. The Willow Creek Mines, Inc., which had reopened the Greenhorn mine in 1939, abandoned the operation during 1941 and removed much of the equipment to the Bullion dis-

trict in Lander County, Nev. The St. Jude Mining Co. operated the St. Jude mine. The J. H. Scott Co. operated the Washington mine throughout 1941; ore was treated in the company 50-ton amalgamation-flotation plant; all jig concentrates were amalgamated before shipment to a smelter, and part of the flotation concentrates were cyanided and part shipped to a smelter. The French Gulch Dredging Co. operated an electric dredge with seventy-six 4½-cubic foot buckets on Clear Creek.

Igo district.—J. P. Brennan operated a dragline dredge, equipped with a dragline excavator and a ¾-cubic yard bucket, on Champion Gulch from January to June 1941. The Clear Creek Dredging Co. operated two dragline dredges; one dragline excavator had a 1½-cubic yard bucket and the other a 2½-cubic yard bucket. The Crow Creek Dredging Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket; 220,000 cubic yards of gravel were washed. R. S. Olson operated a dragline dredge on Daly Gulch, and C. E. Gruwell operated a dragline dredge on the Fish, Forschler, Rais, and Russell ranches during 1941. The Tehama Dredging Co. operated a dragline dredge, which had a dragline excavator with a ¾-cubic yard bucket, at the Gold Acres mine from March 20 to June 30; 242 ounces of gold and 17 ounces of silver were recovered from 48,860 cubic yards of gravel. The San Gruco Co. operated a dragline dredge on the Happy Valley Land and Water Co. property during 1941. The Dobbin Gulch Dredging Co. operated a dragline dredge, using a dragline excavator with a 1¼-cubic yard bucket, on the Montgomery property on Flat Creek from January 1 to May 30; washing 142,160 cubic yards of gravel yielded 853 ounces of gold and 62 ounces of silver. The B. H. K. Mines operated a dragline dredge, equipped with a dragline excavator having a 1¼-cubic yard bucket, on the R. C. Connelly and Robert Litsch properties on Clear Creek from November 15 to December 31; 54,400 cubic yards of gravel yielded 339 ounces of gold and 48 ounces of silver. The Thurman Gold Dredging Co. operated a Yuba electric dredge of the connected-bucket type, with seventy-two 9-cubic foot buckets, on Clear Creek during 1941.

North Cow Creek district.—DeKarr & Herbert operated a dragline dredge, using a dragline excavator with a ¾-cubic yard bucket, on the Fred Kohle property on North Cow Creek from January 16 to March 17, 1941; 297 ounces of gold and 46 ounces of silver were recovered from 23,800 cubic yards of gravel.

Redding district.—The Carino Hewer Lease operated throughout 1941 the Blue Gravel mine owned by the City of Redding; ore was treated by amalgamation and flotation, and the resulting concentrates were shipped to a custom cyanide plant. The Columbia Construction Co., Inc., recovered 2,810 ounces of gold and 301 ounces of silver in preparing 4,038,167 tons of gravel for use in constructing Shasta Dam; two dragline excavators, one with a 5-cubic yard bucket and the other with an 8-cubic yard bucket, were used in delivering gravel to the washing plant.

Shasta district.—A. G. Cadogon leased the Yankee Jack mine in 1941 and treated the ore by amalgamation and flotation; the resulting concentrates were shipped to a smelter.

SIERRA COUNTY

Alleghany district.—The Dickey Exploration Co. operated the Oriental mine throughout 1941; ore was treated by amalgamation and flotation, and the concentrates were shipped to a smelter. The Original Sixteen to One Mine, Inc., largest gold producer in Sierra County, continued to operate its Original Sixteen to One mine; ore was treated by amalgamation and flotation, and the concentrates were shipped to a smelter. In addition, a lessee cyanided a small quantity of old tailings at the property.

Downieville district.—William Richter & Sons operated a dragline dredge in the bed of Yuba River from June 1 to December 31, 1941; 280,000 cubic yards of gravel yielded 1,403 ounces of gold and 179 ounces of silver. C. L. Best operated the Ruby drift mine—by far the largest drift operation in the State—on Rock Creek 3½ miles southeast of Goodyears Bar.

Pike (Slate Range) district.—A lessee operated the Alaska mine throughout 1941; gold ore was treated in a 60-ton, 20-stamp amalgamation-concentration mill; bullion and lead concentrates were shipped. W. C. Ennis worked the Bowman mine and treated 6,300 tons of ore in an amalgamation mill; the bullion contained 644 ounces of gold and 108 ounces of silver.

Poker Flat (Table Rock) district.—The Loftus Blue Lead Mining Co. hydraulicked in the district during 1941.

Port Wine district.—Poverty Hill Properties began to install a connected-bucket dredge with eighty-two 6-cubic foot buckets on May 13, 1941; production began August 21 and continued until the end of the year. This use of a connected-bucket dredge on a high Neocene channel represents a new departure in placer mining in the State.

SISKIYOU COUNTY

Callahan district.—The Etna Gold Dredging Co. operated a connected-bucket dredge, with 3-cubic foot buckets, from January 1 to August 19, 1941. Okoro Mines, Inc., operated a dragline dredge, using a dragline excavator with a 2½-cubic yard bucket, from July 11 to December 31, and recovered 771 ounces of gold and 101 ounces of silver from 245,000 cubic yards of gravel; in addition, a small quantity of gravel at the property was treated by small-scale hand methods. Oro Trinity Dredging Co. operated a dragline dredge, which had a dragline excavator with a 1½-cubic yard bucket, on Scott River from January 1 to May 31. Yuba Consolidated Gold Fields (Siskiyou Unit) operated a connected-bucket dredge, with seventy-two 9-cubic foot buckets, on Scott River throughout 1941.

Deadwood district.—The C. & E. Dredging Co. operated a dragline dredge, using a dragline excavator with a 2-cubic yard bucket, on McAdams and Cherry Creeks from May 9 to December 31, 1941.

Greenhorn district.—The Schroeder Mining & Development Co. operated the Schroeder mine during 1941. The Lincoln Gold Dredging Co. operated a dragline dredge, equipped with a dragline excavator having a 1¼-cubic yard bucket, on the Calkins property 1 mile east of Yreka from July 7 to December 2; 556 ounces of gold and 78 ounces of silver were recovered from 93,742 cubic yards of gravel; in addition,

E. A. Kinkle recovered a small quantity of gold by using a dry-land plant. The same two operators also worked the Rose property.

Humbug district.—Von der Hellen & Webber operated a dragline dredge, which had a dragline excavator with a 2-cubic yard bucket, on Humbug Creek from January 1 to October 1, 1941.

Klamath River district.—Merriam Mining Merger worked the Buzzard Hill mine from May 20 to December 31, 1941; gold ore was crushed to minus-¼-inch and given a cyanide leach. The Northern Dredging Co. operated a dragline dredge on the Allen and the Collins properties from January to May, when the company was dissolved; the company dragline excavator used a 2-cubic yard bucket. The Thompson Dredge, which changed its name to Shasta Dredging Co. November 27, 1941, operated its dragline dredge on Brasswire Gulch 1 mile southwest of Hornbrook from May 12 to August 16, after moving the equipment from the Jenny Lind district in Calaveras County; the dragline excavator used a 2½-cubic yard bucket. Larson Bros. & Harms Bros. operated three dragline dredges throughout 1941; two of the dragline excavators used 5-cubic yard buckets and the other a 3-cubic yard bucket. The William von der Hellen Mining Co. operated a dragline dredge with a dragline excavator, using a 2½-cubic yard bucket; 6,113 ounces of gold and 928 ounces of silver were recovered from 773,700 cubic yards of gravel. McQueen & Downing operated a dragline dredge on the Neville and Silva properties. H. Bauman operated a nonfloating washing plant, to which gravel was delivered by mechanical means, on the Surveyor's Mistake mine on Vesa Creek during 1941. The Yreka Gold Dredging Co. operated a connected-bucket dredge with sixty-seven 6-cubic foot buckets in Seiad Valley.

Liberty district.—Lessees hydraulicked 27,900 cubic yards of gravel at the Joubert mine and recovered 385 ounces of gold and 58 ounces of silver in 1941. The Midland Co., Inc., operated a dragline dredge, which had a dragline excavator with a 1½-cubic yard bucket, on the North Fork of Salmon River throughout the year; 1,950 ounces of gold and 284 ounces of silver were recovered from 350,000 cubic yards of gravel.

Quartz Valley (Oro Fino, Indian Creek) district.—The Beaver Dredging Co. worked a dragline dredge, using a dragline excavator with a 5-cubic yard bucket, on Indian Creek 6 miles west of Fort Jones from April 16 to December 31, 1941.

Salmon River district.—The Salmon River Gold Dredging Co. operated a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on several properties in the Salmon River district during 1941.

Scott Bar district.—The Quartz Hill lode mine was operated in 1941.

STANISLAUS COUNTY

Knights Ferry district.—C. F. Vanciel operated a dragline dredge, employing a dragline excavator with a 1½-cubic yard bucket, on the Anderson, Higginbotham, and Kaasa property from May 13 until December 31, 1941; 2,198 ounces of gold and 179 ounces of silver were recovered from 628,400 cubic yards of gravel. The Placer Properties Co. operated a dragline dredge, using a dragline excavator with a 6-cubic yard bucket, on Stanislaus River 8 miles east of Oakdale throughout 1941.

La Grange district.—The La Grange Gold Dredging Co. operated a connected-bucket dredge with sixty-two 10-cubic foot buckets on Tuolumne River throughout 1941. Yuba Consolidated Gold Fields began operations with a Yuba electric connected-bucket dredge, equipped with sixty-nine 9-cubic foot buckets, on Tuolumne River December 15, 1941. The Tuolumne Gold Dredging Co. operated a connected-bucket dredge with one hundred 12-cubic foot buckets from January 1 to April 13, when the dredge capsized.

TRINITY COUNTY

Hayfork district.—The Cinco Mineros Co. operated a dragline dredge, equipped with a dragline excavator having a 1½-cubic yard bucket, on the Albiez, Crews, Parmenter, Ross, and Trimble properties during 1941. H. S., R. A., and R. I. Smith operated a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on the High Channel mine for 30 days in August and September, and 300 ounces of gold and 40 ounces of silver were recovered from 100,000 cubic yards of gravel; in addition, a small quantity of gold was recovered at the property by hydraulicking.

Helena (North Fork) district.—The North Fork Placer Mining Co. hydraulicked at the North Fork Placer mine on Hydraulic Hill 1 mile from Helena from January 1 to June 30, 1941; 277 ounces of gold and 30 ounces of silver were recovered from 53,500 cubic yards of gravel.

Junction City district.—G. H. Bergin conducted hydraulicking on Canyon Creek from January 1 to July 15, 1941. The Junction City Mining Co. operated a Yuba electric connected-bucket dredge with seventy-five 10-cubic foot buckets along Trinity River near Junction City. Hydraulicking and dragline dredging by Goldfield Consolidated Mines and the Golden Gravels Mining Co. at the Red Hill mine yielded a substantial quantity of gold.

Lewiston district.—The Lincoln Gold Dredging Co. operated two dragline dredges, one using a dragline excavator with a 2½-cubic yard bucket and the other a 1½-cubic yard bucket, on several properties in the Lewiston district during 1941. The properties and recoveries were: Clark-Jansen, 430 ounces of gold and 67 ounces of silver from 109,139 cubic yards of gravel; Costa, 134 ounces of gold and 9 ounces of silver from 26,432 cubic yards of gravel; Dickerson, 149 ounces of gold and 16 ounces of silver from 65,856 cubic yards of gravel; Fancelli, 141 ounces of gold and 19 ounces of silver from 28,170 cubic yards of gravel; Froloff, 2,453 ounces of gold and 158 ounces of silver from 562,732 cubic yards of gravel; and Phillips, 1,134 ounces of gold and 161 ounces of silver from 194,876 cubic yards of gravel. In addition to the dragline production, smaller quantities of gold and silver were recovered by hydraulicking at the Costa and Phillips properties. Havilah Gravels, Inc., operated a dragline dredge, which had a dragline excavator with a 2-cubic yard bucket, on Eastman Gulch from November 23 to December 31; 338 ounces of gold and 48 ounces of silver were recovered from 7,860 cubic yards of gravel. A nonfloating washing plant operated by J. W. Martin and R. W. Setzer on the same property from January 1 to August 1 recovered 163 ounces of gold and 19 ounces of silver from 20,000 cubic yards of gravel. Lewiston Placers hydraulicked at the Lewiston Placers mine from January 27 to July 1 and December 6 to 31.

Salyer district.—The Swanson Mining Corporation operated a hydraulic property during 1941.

Trinity Center district.—The Carrville Gold Co. operated a Yuba electric connected-bucket dredge with seventy-seven 12-cubic foot buckets on the Carr ranch throughout 1941.

Weaverville district.—O. R. Batham operated a dragline dredge on the Bazet Estate property on the East Fork of Stuarts Fork from August 10, 1941, to the end of the year; 626 ounces of gold and 50 ounces of silver were recovered from 205,550 yards of gravel. Batham also carried on smaller operations on the Hook and Ladder and Nugget Bar properties. J. P. Brennan operated a dragline dredge, using a dragline excavator with a ¾-cubic yard bucket, on Browns Creek from July 17 to December 31. Three dragline-dredge operators worked the Hamilton property. Several operators worked the La Grange mine—the Weaver Dredging Co. operated a dragline dredge from January 1 to May 19 and recovered 976 ounces of gold and 89 ounces of silver from 231,124 cubic yards of gravel; and La Grange Placer Mines, Ltd., hydraulicked 113,100 cubic yards of gravel during operations from January 1 to July 1 and from December 16 to 31, recovering 757 ounces of gold and 84 ounces of silver. The Dobbin Gulch Dredging Co. operated a dragline dredge, equipped with a dragline excavator having a 1¼-cubic yard bucket, on the M. A. Brady property from June 13 to December 24; 926 ounces of gold and 80 ounces of silver were recovered from 213,800 cubic yards of gravel. B. H. K. Mines operated a dragline dredge, which had a dragline excavator with a 1½-cubic yard bucket, on the Rehberger property from January 1 to May 2, the M. K. Brown property from May 3 to July 1, the Scharr property from July 20 to September 12, and the Tye property from September 13 to October 22; all operations were on Little Browns Creek. The treatment of 176,000 cubic yards of gravel at the Rehberger property yielded 751 ounces of gold and 41 ounces of silver; 95,000 cubic yards of gravel on the Brown property yielded 405 ounces of gold and 24 ounces of silver; 81,500 cubic yards of gravel on the Scharr property yielded 349 ounces of gold and 28 ounces of silver; and 55,000 cubic yards of gravel on the Tye property yielded 150 ounces of gold and 10 ounces of silver. W. E. Woodbury hydraulicked 20,000 cubic yards of gravel on the Rex mine east of Weaver Creek during 1941. The Hidden Channel, Tout, and Gasper properties were operated by the Viking Dredging Co. from January 1 to February 28, when the operation and equipment were taken over by the Placer Exploration Co. which continued operations until December 2; the dragline dredge used a dragline excavator with a 2-cubic yard bucket.

TOULUMNE COUNTY

East Belt district.—Densmore Mines operated the Densmore mine during 1941. The La Guria Gold Mining Co. ceased operations at the La Guria mine January 23; the mine, held under lease, was returned to its owner. The Mullin-Hampton Dredging Co. operated a dragline dredge, which had a dragline excavator with a 1½-cubic yard bucket, on the Kaplan (Dondero) mine on Woods Creek 1 mile east of Columbia from January 29 to July 15; 365 ounces of gold and 28 ounces of silver were recovered from 85,000 cubic yards of gravel.

Mother Lode district.—Miller & Clemson operated the Eagle-Shawmut mine throughout 1941; the addition of a large ball mill expanded the mill capacity to 500 tons, and ore was treated by amalgamation and flotation. Gravel from the Menke-Hess property near Chinese Camp was treated in a nonfloating washing plant. E. A. Kent operated two dragline dredges, using dragline excavators with 1¾- and 2½-cubic foot buckets, on the Rosasco, Sanguinetti, and Six Bit properties during 1941.

YUBA COUNTY

Browns Valley district.—The Empire Star Mines Co., Ltd., operated the Pennsylvania and Dannebrog mine during 1941.

Dobbins district.—The Dove Mining Co. operated a nonfloating washing plant on the Rose property during 1941.

Smartville district.—The Williams Bar Dredging Co. operated a connected-bucket dredge with eighty-four 6-cubic foot buckets in the bed of Yuba River near Smartville throughout 1941.

Strawberry Valley district.—The R. & M. Mining Co. operated a dragline dredge, using a dragline excavator with a 1¼-cubic yard bucket, at several properties on Slate Creek in 1941. The properties, recoveries, and time periods were as follows: Corley, 423 ounces of gold and 36 ounces of silver from 134,000 cubic yards of gravel between April 15 and June 21; Ophir, 76 ounces of gold and 7 ounces of silver from 15,000 cubic yards of gravel between June 21 and July 8; and First Chance, 691 ounces of gold and 60 ounces of silver from 99,000 cubic yards of gravel between July 21 and November 27.

Yuba River district.—Yuba Consolidated Gold Fields operated a fleet of six dredges at its property in the Yuba River Basin near Hammonton. All the dredges were equipped with 18-cubic foot buckets and electric power; two had 87 buckets each, two had 100 buckets each, one had 126 buckets, and one had 135 buckets.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES

(MINE REPORT)

By A. J. Martin

SUMMARY OUTLINE

The critical character of the need fo. expanding the domestic mine output of copper, lead, and zinc prompted Federal defense agencies to give much attention during 1941 to the Central States region, which in 1940 contributed 45 percent of the total United States mine output of lead, 37 percent of the zinc, and 5 percent of the copper. As a result of the urgent necessity for current information on mine production of copper, lead, and zinc during 1941, the Bureau of Mines inaugurated a series of published monthly estimates showing the mine production of these metals in the United States, including the Central States. Mine production in the Central States under the controlled and ceiling prices prevailing in 1941 did not greatly exceed that of 1940; copper output increased 4 percent, lead 1 percent, and zinc 13 percent.

The silver production of the Central States is that recovered as a byproduct from lead, copper, and zinc-lead ores. No gold was recovered from mines in the Central States in 1941; the 5 ounces produced in 1940 came from a placer prospect.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937-41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938-41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in the Central States, 1937–41, in terms of recovered metals

Year	Mines producing	Ore and old tailings (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
1937	283	26,516,112	51 44	$1,800	206,041	$159,374
1938	229	19,037,105			386,210	249,671
1939	251	22,972,151	[1] 4 00	140	315,953	214,465
1940	416	25,532,085	[1] 5.00	175	353,737	251,546
1941	447	28,959,189			448,824	319,164

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1937	95,466,000	$11,551,386	204,885	$24,176,430	244,045	$31,725,850	$67,614,840
1938	93,486 000	9,161,628	158,873	14,616,316	198,721	19,077,216	43,104,831
1939	87,970,000	9,148,880	198,481	18,657,214	231,716	24,098,464	52,119,163
1940	91,766,000	10,369,558	207,587	20,758,700	244,976	30,866,976	62,246,955
1941	95,680,000	11,290,240	209,362	23,867,268	276,006	41,400,900	76,877,572

[1] From placer prospecting

Silver.—Production of silver in the Central States in 1941 totaled 448,824 fine ounces, comprising 367,688 ounces derived from refining lead bullion, slags, and skimmings recovered from Southeastern Missouri lead ores; 60,796 ounces from copper ore from Michigan; and 20,340 ounces from galena concentrates recovered in milling zinc-lead ore and fluorspar from Illinois.

Copper.—The copper output of the Central States in 1941 came from copper ore from Michigan and lead ore from Missouri; no copper ore was shipped from Missouri during the year, and the copper produced (2,800,000 pounds) was derived from the treatment of residues from lead smelting. The output of refined copper in Michigan increased from 90,396,000 pounds in 1940 to 92,880,000 pounds in 1941, and the average recovery per ton of combined rock and sands treated increased from 20.4 to 21.7 pounds.

Lead.—The mine production of recoverable lead in the Central States was 209,362 tons in 1941 compared with 207,587 tons in 1940. Output from Southeastern Missouri was 164,342 tons in 1941—5,551 tons less than in 1940—and that of the Tri-State region (Kansas, Oklahoma, and Southwestern Missouri) was 41,080 tons, an increase of 5,769 tons over 1940. The output from Central Missouri, Arkansas, Illinois, Kentucky, and Wisconsin totaled 3,940 tons in 1941, an increase of 1,557 tons over 1940.

Zinc.—The mine output of recoverable zinc in the Central States in 1941 was 276,006 tons, a 13-percent increase over 1940. The

Tri-State region produced 94 percent of the total in 1941, 95 percent in 1940, and 97 percent in 1939. In 1941 Oklahoma contributed 64 percent and Kansas 28 percent of the Tri-State output compared with 70 and 25 percent, respectively, in 1940. Unsold stocks of Tri-State zinc concentrates totaled 907 tons at the end of 1941 compared with 2,764 tons in 1940. The zinc output from Southeastern Missouri in 1941 (893 tons) was contained in carbonate concentrates and ore carrying zinc, lead, and iron shipped from old dumps. Production of zinc in Illinois rose from 4,818 tons in 1940 to 9,198 tons in 1941 and that in Wisconsin from 5,770 to 6,238 tons; in Kentucky the output dropped from 1,278 to 427 tons and in Arkansas from 440 to 206 tons.

MINE PRODUCTION BY STATES AND REGIONS

Mine production of silver, copper, lead, and zinc in the Central States in 1941, by States, in terms of recovered metals[1]

State	Mines producing	Ore and old tailings (short tons)	Silver	
			Fine ounces	Value
Arkansas	32	3,000		
Illinois	6	[2] 72,598	20,340	$14,464
Kansas	58	3,696,247		
Kentucky	8	[2] 16,340		
Michigan	7	4,282,448	60,796	43,233
Missouri	93	6,792,594	367,688	261,467
Oklahoma	120	13,883,989		
Wisconsin	123	211,973		
	447	28,959,189	448,824	319,164
Total, 1940	416	25,532,085	353,737	251,546

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas			11	$1,254	206	$30,900	$32,154
Illinois			2,376	270,864	9,198	1,379,700	1,665,028
Kansas			14,538	1,657,332	71,403	10,710,450	12,367,782
Kentucky			282	32,148	427	64,050	96,198
Michigan	92,880,000	$10,959,840					11,003,073
Missouri	2,800,000	330,400	165,909	18,913,626	21,932	3,289,800	22,795,293
Oklahoma			25,021	2,852,394	166,602	24,990,300	27,842,694
Wisconsin			1,225	139,650	6,238	935,700	1,075,350
	95,680,000	11,290,240	209,362	23,867,268	276,006	41,400,900	76,877,572
Total, 1940	91,766,000	10,369,558	207,587	20,758,700	244,976	30,866,976	[1] 62,246,955

[1] Grand total value for 1940 includes gold from placer prospecting in Indiana, as follows. 5 fine ounces, valued at $175. No output of gold in 1941. See preceding table.
[2] Excludes lead-bearing material mined with fluorspar and from which some lead was recovered as a byproduct of the mining and milling of the fluorspar.

Mine production of lead and zinc in the Central States in 1941, by regions

Region	Lead [1]		Zinc [2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	53,690	$3,597,132	478,403	$23,960,568	$27,557,700
Southeastern Missouri [3]	228,572	15,404,226	5,192	73,202	15,477,428
Upper Mississippi Valley [4]	1,810	121,301	14,893	757,833	879,134
Kentucky-Southern Illinois	3,866	219,064	[5] 14,401	687,270	906,334
Northern Arkansas	10	600	[6] 622	16,132	16,732
	287,948	19,342,323	513,511	25,495,005	44,837,328
Total, 1940	283,045	17,162,573	454,882	18,938,538	36,101,111
Recoverable metal:					
Joplin or Tri-State	41,080	4,683,120	258,837	38,825,550	43,508,670
Southeastern Missouri [7]	164,388	18,740,232	1,100	165,000	18,905,232
Upper Mississippi Valley [4]	1,345	153,330	7,956	1,193,400	1,346,730
Kentucky-Southern Illinois	[8] 2,538	289,332	7,907	1,186,050	1,475,382
Northern Arkansas	[9] 11	1,254	206	30,900	32,154
	209,362	23,867,268	276,006	41,400,900	65,268,168
Total, 1940	207,587	20,758,700	244,976	30,866,976	51,625,676

[1] Includes galena and small quantity of lead carbonate concentrates
[2] Includes sphalerite and relatively small quantity of zinc carbonate and silicate concentrates.
[3] Includes 64 tons of lead concentrates and 472 tons of zinc concentrates from Central Missouri.
[4] Region includes Iowa, Northern Illinois, and Wisconsin; no production in Iowa from 1918 to 1941, inclusive.
[5] Includes 688 tons of zinc-lead concentrates averaging 47.53 percent zinc and 8.14 percent lead.
[6] Includes 81 tons of zinc-lead carbonate ores and concentrates.
[7] Includes 46 tons of lead and 207 tons of zinc from Central Missouri.
[8] Includes 54 tons contained in zinc-lead concentrates.
[9] Includes 5 tons contained in zinc and zinc-lead carbonate ores and concentrates.

The report of this series for 1930 (chapter of Mineral Resources of the United States, 1930, pt. I) gives the areas included in the seven lead- and zinc-producing regions of the Central States. Mineral Resources, 1914, contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State from 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907. Subsequent records year by year are found in Mineral Resources and Minerals Yearbook.

Of a total of 477,126 tons of blende concentrates produced in 1941 in the Tri-State region, 74,036 tons—470 tons less than in 1940—were derived from old tailings.

Quantity and tenor of ores.—The quantity and tenor of ores and old tailings treated in Kansas, Michigan, Missouri, Oklahoma, and Wisconsin from 1939 to 1941 are shown in the table that follows. Comparable figures for Kentucky and Illinois cannot be given because the lead and zinc concentrates shipped from some of the mines are recovered as byproducts in the concentration of the fluorspar that they accompany, and the metal content of the crude ore raised cannot be calculated. In Arkansas very little ore was mined annually from 1918 to 1941, and the tenor of most of the ore treated (generally by small mills or hand jigs) was not determined by the operators.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in some [1] Central States, 1939–41, by States

State	1939		1940		1941	
	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]
	Short tons	*Percent*	*Short tons*	*Percent*	*Short tons*	*Percent*
Kansas	3,701,300	2.45	3,153,800	2.40	3,696,247	2.55
Michigan	4,603,751	.96	4,438,219	1.02	4,282,448	1.08
Missouri	5,650,800	3.12	6,457,400	2.94	6,792,594	2.85
Oklahoma	8,802,900	2.00	11,250,400	1.80	13,883,989	1.52
Wisconsin	213,400	3.26	190,326	3.61	211,973	3.86
	22,972,151		25,490,145		28,867,251	

[1] Only small-scale intermittent mining done in Arkansas from 1918 to 1941; Kentucky and Illinois excluded because part of the metal output (lead and zinc) was a byproduct of fluorspar mining, and the quantity of metal-bearing material hoisted could not be determined.

[2] The percentages represent metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in other Central States the metals are lead and zinc combined, relative proportions of which are shown in third table of this chapter and in tables of tenor of ore given in sections devoted to the respective States.

MINING AND METALLURGIC INDUSTRY

Most of the ore mined in the Central States is concentrated by the companies producing it, but that mined by some of the large producing companies in the Tri-State and Upper Mississippi Valley regions is sent to central mills, which also afford an outlet for crude ore produced by individuals and partnerships working small mines or gouging in large mines abandoned by former operators. Gravity concentration continues to be an important factor in the treatment of ores, although flotation is used in nearly all the large mills to supplement the gravity method or as the principal method of treatment. The concentrates generally have an established market. In 1941 copper concentrates from Michigan were smelted at plants at Hubbell and Houghton, Mich.; lead concentrates from Southeastern Missouri were sent to smelters at Herculaneum, Mo., and Alton, Ill.; and lead concentrates from the Tri-State district went to smelters or pigment plants at Galena and Coffeyville, Kans., and Alton and Hillsboro, Ill. Zinc concentrates from the Tri-State district moved to plants at Bartlesville, Blackwell, and Henryetta, Okla.; Coffeyville and Galena, Kans.; Fort Smith and Van Buren, Ark.; Danville, East St. Louis, Hillsboro, and La Salle, Ill.; Donora and Josephtown, Pa.; and Moundsville, W. Va. The lead and zinc concentrates from Wisconsin, Illinois, and other scattered districts in the Central States were shipped to the plants that treated the concentrates from the Southeastern Missouri and Tri-State districts.

REVIEW BY STATES

ARKANSAS

Concentrates and crude smelting ore shipped from lead and zinc mines in Arkansas in 1941 totaled 632 tons containing 11 tons of recoverable lead and 206 tons of zinc compared with 1,570 tons containing 55 tons of lead and 440 tons of zinc in 1940. About 32 small mines and prospects in Boone, Marion, Newton, and Searcy Counties contributed to the output in 1941. Most of the operators hand-jigged or sorted their ore at the mines and sold it in small lots to the Manda Industrial Corporation at Harrison, which reshipped it to smelters or other buyers in carlots. The Hurricane Mining Co. did development work at the Big Hurricane and Excelsior mines in Searcy County and installed a 75-ton mill at the Excelsior near St. Joe; the mill treated about 800 tons of sulfide ore yielding 60 tons of concentrates assaying 58.7 percent zinc. The rest of the concentrates and ore shipped was carbonates or silicates and averaged 37 percent zinc and 2 percent lead. I. A. Lower treated 150 tons of ore and 50 tons of old tailings in the McIntosh mill at Rush, which yielded 20 tons of concentrates. At the Edith mine near Rush the Maricon Mining Co. drove 122 feet of tunnel and a 48-foot drift, did construction work on a 100-ton mill, and shipped 11 tons of sorted crude ore. Other producing mines included the Gloria, Coon Hollow, and Jack Pot in Boone County; Monte Cristo, Red Cloud, and Sure Pop in Marion County; and Lone Star in Searcy County.

ILLINOIS

Northern Illinois (see under Wisconsin for output data).—Gill Brothers operated the old Hughlett and Gray mine in Jo Daviess County from February through December 1941 and shipped 13,639 tons of ore averaging 15.32 percent zinc and 1.03 percent lead to the Vinegar Hill Zinc Co. custom flotation mill at Cuba City, Wis. Operations consisted of robbing pillars, slabbing off sides of old drifts, and taking up bottoms of old stopes. A little zinc ore was cleaned up and shipped from the old Blewett mine in the Galena district.

Southern Illinois.—The Mahoning Mining Co. operated its 200-ton selective flotation mill at Rosiclare continuously in 1941 on zinc-lead fluorspar ore from the company-owned W. L. Davis mine and adjacent leased properties near Cave in Rock. The ore occurs generally in flat-lying or blanket formation with alternating layers, one consisting of fluorspar and the other mostly of sphalerite and galena; it is mined through vertical shafts from open stopes supported by pillars and is transported to the mill by trucks. The commercial products of the mill (in the order recovered) are lead concentrates, zinc concentrates, and fluorspar concentrates (mostly of acid grade). Hillside Fluor Spar Mines continued to ship lead concentrates recovered as a byproduct in the milling of fluorspar, and individuals shipped small lots of lead concentrates from Freeport and Rosiclare. The total output of lead concentrates in Southern Illinois in 1941 was 3,545 tons averaging 64.94 percent lead and 5.74 ounces of silver to the ton, and that of zinc concentrates was 13,292 tons averaging 62.53 percent zinc. Production (in terms of recovered metals) amounted to 2,256 tons of lead, 20,340 ounces of silver, and 7,480 tons of zinc

compared with 1,500 tons of lead, 4,766 ounces of silver, and 4,812 tons of zinc in 1940.

KANSAS

Mine production of lead and zinc increased substantially in Kansas in 1941. The recoverable lead output rose from 11,927 tons in 1940 to 14,538 tons in 1941 and zinc from 57,032 to 71,403 tons. Zinc derived from old tailings decreased from 11 percent of the total in 1940 to 6 percent in 1941. About 58 mines and 18 mills were operated all or part of 1941 compared with 34 mines and 20 mills in 1940. Prices of concentrates and other general details of mining in the Tri-State region are given in the pages of this chapter devoted to Southwestern Missouri.

Mines and mills near Baxter Springs yielded 4,734 tons of lead concentrates and 34,533 tons of zinc concentrates in 1941. The St. Louis Smelting & Refining Co. operated its Ballard mill continuously on ore from the Ballard, Bailey, Clark, English "O", and Shanks mines; the mill output of both lead and zinc concentrates increased materially over 1940. In July 1941 the Bilharz Mining Co. began milling ore from the Bilharz-Brewster mine, at which the company had been conducting a difficult acid-water fight to unwater lower levels and reopen old ground; the company mill also continued to treat ore from the L. D. Brewster mine in Oklahoma. The Madison Mining Co. operated the Peru (old Sunflower) mine and mill steadily. The Lula Bell Mining Co. worked the Opperman mine, treating the ore in the company mill near Hockerville, Okla. Ore from the Robob and Oldham mines was shipped to the Central and Guaranty mills, respectively, in Oklahoma. The Wade custom mill treated 26,222 tons of ore received from small-scale operators in Kansas and Oklahoma.

Production from the Blue Mound-Treece area was 13,939 tons of galena and 87,920 tons of blende. The Eagle-Picher Mining & Smelting Co. operated its Westside-Barr and Webber mines and mills continuously; production of zinc from the Westside-Barr mine showed a large increase over 1940 and was the highest in the Tri-State district for a single mine. The Federal Mining & Smelting Co. ran its Muncie mill on ore from the Muncie-Tar Creek-Semple Group; the ore from the Federal Jarrett mine was sent to the company Gordon central mill in Oklahoma. Kansas Explorations, Inc., operated its Jarrett lease and mill northeast of the Federal Jarrett from January to November. Ore from the Cherokee mine was shipped to the Woodchuck mill in Oklahoma. The Youngman mill handled tailings until July and was then dismantled and moved to the Robinson mine (operated by the Harris Mining Co.), where it was rebuilt for handling mine "dirt" and operated the rest of the year on ore from the Robinson mine, which had been shipping to the Beck mill at Picher, Okla. Ore from the Bendelari, Black Eagle, Big John, Chubb, Wilbur, and Wright mines was shipped to the Central mill at Cardin, Okla. The Dines Mining Co. mill treated company and custom ore, mostly from the Lindsey, Northern, and Southern mines. The New Blue Mound Mining Co., J. A. Worley, and the Pilot Oil Co. also operated mine mills. Operators of tailing mills in Kansas were the Captain Milling Co., C. Y. Semple, and H. D. Youngman.

The Kansas part of the Waco district yielded 15 tons of galena concentrates and 8,361 tons of blende. The St. Louis Smelting & & Refining Co. reopened its No. 9 group of mines and 800-ton mill in April and operated them the rest of the year; some of the ore milled came from the Missouri part of the property The F. W. Evans mill (formerly R. H. & G.) treated ore from leases on the O'Neill land (partly in Kansas and partly in Missouri), the St. Louis Smelting & Refining Co. land, and the Reynolds land. The Peacock mine and mill at the old Badger camp were operated on a small scale from January to September. At Galena, Fred Childress & Sons unwatered the Bailey shaft on the Southside land and shipped some ore late in the year to the Central mill in Oklahoma.

Mine shipments of lead and zinc in Kansas, 1937–41

Year	Mines producing	Lead concentrates		Zinc concentrates		Metal content [1]			
						Lead		Zinc	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	42	20,559	$1,454,507	151,646	$6,476,064	16,008	$1,888,944	80,300	$10,439,000
1938	31	19,909	1,023,851	133,546	4,132,248	15,239	1,401,988	73,024	7,010,304
1939	30	17,845	1,010,106	126,235	4,300,365	13,697	1,287,518	68,971	7,172,984
1940	34	15,424	907,296	105,070	4,420,360	11,927	1,192,700	57,032	7,186,032
1941	58	18,888	1,264,147	131,406	6,595,506	14,538	1,657,332	71,403	10,710,450

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the value of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1940–41

	1940		1941	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled ..... short tons	1,843,800	1,310,000	2,446,207	1,250,040
Total concentrates produced				
Galena ..... do	15,290	134	18,886	2
Sphalerite ..... do	93,537	11,533	123,000	8,406
Ratio of concentrates to ore, etc				
Lead ..... percent	0.83	0.01	0.77	.....
Zinc ..... do	4.98	.88	5.03	0.67
Metal content of ore, etc. [1]				
Lead ..... do	.66	.01	.61	.....
Zinc ..... do	3.01	.53	3.04	.40
Average lead content of galena concentrates ..... do	78.99	70.0	78.54	50.0
Average zinc content of sphalerite concentrates ..... do	60.36	59.91	60.48	58.9
Average value per ton				
Galena concentrates	$58.82	$59.00	$66.93	$56.00
Sphalerite concentrates	42.56	38.13	50.32	48.38

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available

KENTUCKY

Shipments of lead and zinc ore and concentrates from Kentucky in 1941 comprised 321 tons of galena averaging 72.27 percent lead, 475 tons of zinc-lead sulfide averaging 54.32 percent zinc and 10.95

percent lead, 616 tons of zinc carbonate averaging 36.2 percent zinc and 1 percent lead, and 18 tons of sphalerite averaging 62.53 percent zinc. The recoverable metal content of the combined concentrates was 282 tons of lead and 427 tons of zinc in 1941, compared with 360 tons of lead and 1,278 tons of zinc, in 1940. The drop in zinc production in 1941 resulted from the closing late in 1940 of the "Hutson" mine and 100-ton mill of the Eagle Fluor Spar Co. near Salem, Livingston County; the only shipments from the mine in 1941 were 55 tons of ore cleaned up from a waste dump. The Twin Valley Mining Co. operated the Gratz mine and mill at Gratz, Owen County, intermittently from May to December and shipped several cars of zinc and lead sulfide concentrates. The United States Coal & Coke Co. Fluorspar Division shipped some zinc-lead and lead concentrates, and the National Fluorspar Co. and the Mineral Ridge Fluor Spar Co. shipped byproduct lead concentrates. A 200-ton lot of ore from Kentucky was sent to the Mahoning mill at Rosiclare, Ill., for experimental milling. Zinc carbonate log-washer concentrates were shipped from the K-K-Mining Co. land near Sheridan and the Blue property near Mexico. The Eagle-Picher Mining & Smelting Co. continued developing its zinc-lead property 6 miles east of Marion.

MICHIGAN

Copper totaling 92,880,000 pounds was produced in Michigan in 1941, an increase of 2,484,000 pounds (3 percent) over 1940. The increase resulted from a rise in the average grade of both mine ore and old tailings treated; the quantity of mine ore milled decreased from 1,827,119 tons in 1940 to 1,741,961 tons in 1941 and that of old tailings from 2,611,100 to 2,540,487 tons.

The adverse effect of rising operating costs on copper production in Michigan under the ceiling price of 12 cents a pound, effective August 6, 1941, was recognized by the Office of Price Administration. In November special arrangements were consummated under which the Procurement Division of the Treasury Department contracted to purchase the copper output of three "high-cost" mines for 6 months at a price per pound equivalent to the "out-of-pocket" cost of production for the 6-month period ended June 30, 1941. The price was adjusted to include a wage increase of $1 a day and expenses incident to the increase, plus an additional cent a pound if the total price a pound is lower than the cost of production during the contract period. Other stipulations provide an incentive for operators to reduce costs and fix maximum prices at 15 and 16 cents a pound. A contract, with similar provisions, for reopening a fourth "high-cost" copper mine in Michigan was executed early in 1942.

The concentrate ("mineral") produced at mills in Michigan in 1941 was smelted at plants of the Calumet and Hecla Consolidated Copper Co. at Hubbell and the Copper Range Co. at Houghton. Copper bullion that carries an amount of silver sufficient to make the separation and recovery of this metal profitable is cast into anodes and shipped to electrolytic refineries outside the State. The quantity of silver recovered from anodes shipped was 60,796 fine ounces in 1941 compared with 88,657 ounces in 1940.

Mine production of gold, silver, and copper in Michigan, 1937–41 [1]

Year	Gold (fine ounces)	Silver (fine ounces)	Copper [2]			Concentrate ("mineral") [3]		Ore ("rock") (short tons) [4]
			Pounds	Yield				
				Pounds per ton of ore ("rock")	Percent	Pounds	Yield (percent copper)	
1937	51.44	25,454	94,928,000	22.6	1.13	148,172,000	64.1	[5] 4,197,881
1938		93,634	93,486,000	24.9	1.24	144,964,890	64.5	3,757,705
1939		101,878	87,970,000	19.1	.96	136,771,339	64.3	4,603,751
1940		88,657	90,396,000	20.4	1.02	138,451,495	65.3	4,438,219
1941		60,796	92,880,000	21.7	1.08	141,100,268	65.8	4,282,448

[1] Figures based upon actual recovery of copper from "mineral" smelted and estimated recovery from "mineral" not smelted during year.
[2] Includes copper from sands.
[3] Includes "mineral" from sands.
[4] Includes sands.
[5] Excludes 600 tons of siliceous ore.

Value of silver and copper produced in Michigan mines, 1937–41

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")				Total	Per ton of ore ("rock")	
1937	$19,689	$11,486,288	$2.74	$11,505,977	1940	$63,045	$10,214,748	$2.30	$10,277,793
1938	60,531	9,161,628	2.44	9,222,159	1941	43,233	10,959,840	2.56	11,003,073
1939	69,154	9,148,880	1.99	9,218,034					

The Calumet and Hecla Consolidated Copper Co. operated the Ahmeek and Peninsula groups on the Kearsarge lode throughout 1941 and in October began working the adjacent Douglass property under a 25-year lease from the Copper Range Co. During the year the company obtained a modification of its lease and option on the Peninsula group under which the term of the lease and option might be extended from year to year after July 1, 1943, upon payment of yearly installments on the purchase price. In July 1941 the company purchased all the lands of the Ojibway Mining Co. at public sale; these comprised 3,000 acres north of and contiguous to the Peninsula property. Development and mining on the Peninsula and Douglass properties were carried on from the Ahmeek mine workings, which are reached through three inclined shafts 7,043, 5,903, and 5,157 feet deep. Development done in 1941 comprised 334 feet of shaft, 10,094 feet of drifts, and 43,942 feet of diamond drilling. The ore produced was treated in the 6,800-ton Ahmeek stamp mill by gravity concentration followed by flotation of the fines. The annual company report to stockholders shows an output of 28,670,000 pounds of copper from mine ore and 32,766,000 pounds from tailings treated in reclamation plants. It was estimated that at the 1941 rate of production the conglomerate tailings will be exhausted in about 2½ years.

Operations at the Calumet and Hecla reclamation plants at Lake Linden and Hubbell in 1941 and for the entire period of their operation

	1941	Since beginning
Quantity treated short tons	2,295,000	38,365,000
Assay headings percent	0.835	0.671
Assay tailings do	.117	.123
Refined copper produced pounds	32,766,000	419,791,000
Refined copper produced per ton treated do	14 28	10 94

The Copper Range Co. operated its Champion and Globe mines and 2,500-ton mill at Freda throughout 1941, except for about 3 weeks following a fire at the mine on November 22; the company tailings-recovery plant was run from April to December, inclusive. The Champion mine is opened by a 70° shaft 5,361 feet deep, through which the workings of both mines are reached. Copper recovered from 304,480 tons of mine ore and 245,487 tons of sands treated totaled 16,677,304 pounds. The average yield of fine copper per ton of mine rock was 52.38 pounds compared with 57.72 pounds in 1940. The concentrates produced in the mills were treated in the company smelter, which also handled custom concentrates from the mills of the Isle Royale Copper Co. and the Quincy Mining Co.

The Isle Royale Copper Co. mine and 2,000-ton stamp mill were run continuously in 1941, except for a shut-down of about a week in September owing to a labor strike at the mine. The quantity of crude ore produced decreased from 391,073 tons in 1940 to 316,598 tons in 1941, owing mainly to a reduction in the output from No. 5 shaft; production from No. 4 shaft nearly equalled that in 1940. Fine copper yielded per ton of rock treated averaged 21.223 pounds in 1941 and 19.897 pounds in 1940.

The Quincy Mining Co. operated its mine and mill steadily in 1941. The tonnage of rock treated and the yield of copper per ton were both slightly lower than in 1940.

MISSOURI

The total value of recoverable silver, copper, lead, and zinc produced from Missouri mines was $22,795,293 in 1941 compared with $19,145,700 in 1940. The silver output in 1941 (367,688 fine ounces valued at $261,467) and the copper (2,800,000 pounds valued at $330,400) were byproducts recovered in smelting and refining lead concentrates from Southeastern Missouri. These two metals occur in such small quantity to the ton of concentrates that no value is attached to them in the sale of the concentrates. The lead output of the State came largely from the Southeastern Missouri region and the zinc mostly from Southwestern Missouri. The Central district of Missouri produced 46 tons of recoverable lead and 207 tons of zinc in 1941; these figures are included with those of Southeastern Missouri in the table that follows.

The total output of lead concentrates in Missouri was 230,746 tons with a recovered lead content of 165,909 tons in 1941 compared with 235,746 and 172,052 tons, respectively, in 1940. The total output of zinc concentrates was 44,982 tons with a recovered zinc content of 21,932 tons compared with 24,539 and 12,703 tons, respectively, in 1940.

Mine production of lead and zinc in Southeastern and Central Missouri, 1937–41

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value [2]	Short tons	Value	Short tons	Value	Short tons	Value
1937	209,937	$14,360,271	24	$720	153,205	$18,078,190	11	$1,430
1938	163,500	9,040,593			118,870	10,936,040		
1939	210,526	12,339,360			153,522	14,431,068		
1940	232,871	14,269,600	[3] 815	20,000	169,908	16,990,800	233	29,358
1941	228,572	15,404,226	[4] 5,192	73,202	164,388	18,740,232	1,100	165,000

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[2] Values given are to a certain extent arbitrary, as part of the lead concentrates are smelted by the producer.
[3] Includes 500 tons of zinc carbonate ore containing 106 tons of recoverable zinc.
[4] Includes 4,720 tons of zinc-lead carbonate concentrates containing 893 tons of recoverable zinc and 172 tons of lead.

Tenor of lead ore and concentrates in Southeastern Missouri disseminated-lead district, 1937–41

	1937	1938	1939	1940	1941
Total lead ore .... short tons	5,012,631	3,668,400	5,127,000	5,837,400	5,737,230
Galena concentrates in ore .... percent	4.18	4.45	4.11	3.99	3.98
Zinc content of ore .... do	(1)	(1)	(1)	(1)	(1)
Average lead content of galena concentrates ... do	74.5	74.8	74.4	74.45	73.31
Average value per ton of galena concentrates	$68.42	$55.29	$58.61	$61.28	$67.39
Average zinc content of sphalerite concentrates percent	51.6				
Average value per ton of sphalerite concentrates	$30.00				

[1] Figures not available.

Mine production of lead and zinc in Southwestern Missouri, 1937–41

Year	Lead concentrates				Zinc concentrates				Metal content [1]			
	Galena		Carbonate		Sphalerite		Silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	5,587	$368,231	173	$8,160	37,715	$1,611,158	1,690	$43,411	4,426	$522,268	20,589	$2,676,570
1938	4,130	209,758	104	3,100	18,474	560,089	1,022	17,931	3,157	290,444	10,226	981,696
1939	3,674	199,885			27,741	944,587	949	16,757	2,759	259,346	15,096	1,569,984
1940	2,818	158,556	57	2,446	22,917	959,356	807	10,965	2,144	214,400	12,470	1,571,220
1941	2,084	125,730	90	4,379	38,513	1,923,472	1,277	14,355	1,521	173,394	20,832	3,124,800

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Southwestern Missouri, 1940–41

	1940		1941	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ... short tons	497,500	117,000	777,351	252,603
Total concentrates produced:				
Lead ... do	2,875	----	2,147	27
Zinc ... do	22,850	874	37,594	2,196
Ratio of concentrates to ore, etc.:				
Lead ... percent	0.58	----	0.28	0.01
Zinc ... do	4.59	0.75	4.84	.87
Metal content of ores, etc.:[1]				
Lead ... do	.44	----	.20	.006
Zinc ... do	2.68	.43	2.83	.47
Average lead content of galena concentrates .. do	76.4	----	72.8	51.9
Average lead content of lead carbonate ... do	59.7	----	52.22	----
Average zinc content of sphalerite concentrates ... percent	59.5	59.5	59.74	53.82
Average zinc content of silicates and carbonates ... percent	25.7	43.5	22.47	----
Average value per ton:				
Galena concentrates	$56.27	----	$60.62	$38.52
Lead carbonate concentrates	42.91	----	48.66	----
Sphalerite concentrates	41.90	$40.74	50.34	43.45
Zinc silicates and carbonates	12.13	27.00	11.24	----

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

Southeastern and Central Missouri.—The disseminated-lead district of Southeastern Missouri—largest lead-producing district in the United States—yielded 164,342 tons of recoverable lead in 1941 compared with 169,893 tons in 1940. The bulk of the production in 1941, as in the past, came from St. Francois County, where the St. Joseph Lead Co. operated four groups of mines and the Bonne Terre, Desloge, Federal, and Leadwood mills with a total daily capacity of 21,100 tons of ore. Treatment is by table concentration followed by flotation. The ore occurs in extensive flat-lying deposits in limestone and is mined from open stopes supported by pillars. Electric-powered mechanical loaders and locomotives are used for loading and underground haulage. Thirteen shafts averaging 440 feet in depth were operated in 1941. Development done comprised 41,585 feet of drifts and 1,240,845 feet of diamond drilling. In Madison County the Mine La Motte mine and 1,000-ton mill of the Mine La Motte Corporation (50 percent owned by the St. Joseph Lead Co.) were run steadily. Two shafts, 116 and 308 feet deep, were operated. Development done totaled 2,884 feet of drifts and 29,468 feet of churn drilling. The Ozark Lead Co. mined on the Fleming tract near Fredericktown from January to July; no further production was made from the property until March 17, 1942, when it was reopened by the Fredericktown Lead Co., which had purchased the Ozark Lead Co. mining lease and the Clark & Hallock mill. Of the 228,508 tons of lead concentrates made in 1941 in Southeastern Missouri, 106,232 tons were flotation concentrates. Local buyers and small-scale operators shipped 346 tons of galena recovered in shallow workings (including barite mines) in Jefferson, St. Francois, and Washington Counties.

The zinc output of Southeastern Missouri in 1941 was contained in zinc-lead carbonate concentrates recovered in log washers and

hand jigs from old dump material on the properties of the Valle Mining Co. north of Bonne Terre and the Tausig Estate 9 miles west of De Soto.

In Central Missouri the Wemhaner Mining Corporation produced 472 tons of 49-percent zinc sulfide concentrates and 6 tons of galena in its 100-ton jig-concentration mill, operated intermittently on ore from the leased open-cut mine on the Monarch Coal & Mineral Co. land in Moniteau County. Otis and E. M. Sullens shipped 58 tons of galena recovered in their 10-ton power jig from ore from an open-cut on the Lowery property near Enon.

Southwestern Missouri.—The method of marketing the mine output in the Tri-State or Joplin lead and zinc region (Southwestern Missouri, Kansas, and Oklahoma) differs from that employed in other parts of the country where miners receive pay for ore upon the basis of the assay content of metal at a certain price per unit f. o. b. smelter and freight charges are deducted from the smelter settlement if not paid in advance or guaranteed by the shipper. In the Tri-State region compensation is paid per ton of concentrates f. o. b. mine bins. In effect, however, this is equivalent to paying for the metal contained, inasmuch as the price per ton is based upon a sliding scale determined by the assay content. The standard for zinc sulfide concentrates is 60 percent zinc and for lead sulfide 80 percent lead. No base prices have been quoted in recent years for zinc silicate and lead carbonate concentrates, as the output has been scattered and small.

The total value given in this report for all concentrates produced in the Tri-State region is based upon actual receipts by the sellers and not upon quoted prices. The quoted price is that paid for medium quantities or carlots; small lots bring less. The quoted weekly price a ton for Tri-State zinc blende concentrates at Joplin from January 1 to September 6, 1941, was $48.00. A slight adjustment upward to $48.58 was made in the next quotation (September 12), and this price held until October 10, when the quotation was raised to $55.28 and remained at this figure the rest of the year. The quoted weekly price for galena concentrates from January 4 to February 8 was $64.54; February 15 to March 1, $66.70; March 8 to 22, $68.14; March 29 to June 28, $69.58; and July 5 to January 3, 1942, $68.64. The average price paid for zinc silicate and carbonate shipped in 1941, most of which was low-grade, was $11.24 a ton.

Production of zinc concentrates in the Tri-State region increased from 429,778 tons valued at $18,062,867 in 1940 to 478,403 tons valued at $23,960,568 in 1941, and that of lead concentrates from 46,212 tons valued at $2,724,795 to 53,690 tons valued at $3,597,132. Unsold stocks in bins December 31, 1941, totaled 907 tons of zinc concentrates and 1,276 tons of lead concentrates compared with 2,764 tons and 186 tons, respectively, as of December 28, 1940. Flotation concentrates comprised 53.6 percent of the sphalerite from the Oklahoma-Kansas area and 14.7 percent of that from Southwestern Missouri.

During 1941 Federal defense agencies made surveys covering all phases of the zinc- and lead-mining industry of the Tri-State region in an effort to determine under what conditions output could be increased or at least maintained at its present level during the next few years. The data obtained indicated that owing to depletion of ore reserves and rising operating costs the rate of production attained during the spring of 1941 (around 40,000 tons of zinc concentrates

and 4,300 tons of lead concentrates monthly) was close to the maximum that the field could produce at the prices then prevailing for concentrates. Measures subsequently taken by the Government, which greatly improved the outlook for maintaining and expanding production, were a raise of 1 cent a pound in the price of zinc allowed on October 9, which brought an increase of $6.70 a ton in the price of zinc concentrates at Joplin; the granting of high-priority preference ratings on mine supplies and equipment, which became operative in the Tri-State district late in October; approval early in January 1942 of an advance of 0.65 cent a pound in the price of lead; and announcement of the plan to pay premium prices for over-quota production of copper, lead, and zinc for a 2½-year period beginning February 1, 1942.

The premium prices applied to concentrates of the Tri-State district amount to $28.05 a dry ton of 60-percent zinc concentrates and $39.60 for 80-percent lead concentrates. On March 1, 1942, Leslie H. McColgin was designated representative for the Metals Reserve Co. to handle premium payments on the production of Tri-State sulfide concentrates in excess of monthly quotas. The settlement plan is essentially as follows: Each producer who is eligible for the premium submits a request to McColgin, listing the total amount of concentrates delivered and sold for which payment has been or will be made and the amount of such concentrates which, being excess production, is eligible for a premium; he also furnishes a sworn affidavit. McColgin compiles statements of all requests received in a given period and sends them, with the sworn producers' affidavits, to the Metals Reserve Co., which arranges for premium payments to be made; checks made payable to the producers are sent to McColgin for distribution. Any deficiency in monthly deliveries of a given metal below the monthly production quota of any producer must be made up in the next succeeding month or months before such producer can receive any premium payment on excess-quota production of that metal. The first premium-payment checks made out to Tri-State operators were delivered March 17, 1942.

Production of recoverable zinc in Southwestern Missouri increased from 12,470 tons in 1940 to 20,832 tons in 1941 and lead decreased from 2,144 to 1,521 tons. About 80 mines and 26 mills, large and small, produced in 1941, compared with 80 and 17, respectively, in 1940. The Oronogo and Wentworth-Stark City areas contributed 67 percent of the total zinc output in 1941. At Oronogo, the Oronogo Mutual Mining Co. extracted 202,072 tons of ore from the Oronogo Circle open pit and in addition removed 409,790 tons of waste rock and overburden. The ore was milled in the Eagle-Picher American mill. From January to June, Kansas Explorations, Inc., sank two shafts, erected a hoisting derrick, and built a 600-ton mill on its Snapp property 2½ miles northwest of Oronogo; mining and milling were begun in July and continued the remainder of the year. The F. & M. Mining Co. operated the La Tosca mine and mill, and Fenix & Sons shipped crude ore from a shaft on the Oronogo Mutual property to the Central mill in Oklahoma. The output from the Wentworth-Stark City area came largely from the Dungy, Navy Bean, and Reynolds mines, operated by the Eagle-Picher Mining & Smelting Co., which milled the ore in its Navy Bean mill, completed in December 1940. The Wentworth Mining & Milling Co. and the Midwestern Mining & Sand Co. mills near Wentworth were operated part of 1941.

About October 20 the Federal Mining & Smelting Co. resumed operations at its Granby-American group of mines and mill, which had been shut down for 15 years. At Stotts City the Capital Mining Co. mine and mill were operated from June to December, except for time lost when the mine was flooded by heavy rains in October. The Stotts City Mining Co. worked on unwatering and developing its property. The Playter 100-ton custom mill near Waco milled ore from the Waco, Belleville, and Carthage area; and the F. W. Evans and St. Louis No. 9 mills in Kansas treated considerable ore mined from the Missouri part of the Waco district. In the Thoms station area the St. Louis Mining & Milling Co. operated its mill (old Grasselli) intermittently on ore mined by lessees on the Tabor-Velie land. The Sciota Milling Co. 1,000-ton tailing mill, built on the Missouri Zinc Fields Co. land near Webb City early in the year, was operated steadily after April. About 10 small mills in the vicinity of Webb City, Joplin, Alba, and Spurgeon were operated intermittently. Lessees on the Connor Investment Co. land in the Chitwood area shipped ore to custom mills. In November the Northside Mining Co. struck a rich deposit of zinc ore at a depth of 160 feet while sinking a shaft on the leased St. Louis-Joplin Lead & Zinc Co. land ½ mile northwest of Chitwood. The Mary Arnold mine and mill near Ozark (taken over in August by the Nibeck Mining Co.) continued producing. At Aurora the Harris Mining Co. completed a mill on the Scott-Phelps-Scott property and produced 85 tons of sphalerite. Zinc carbonate from scattered small mines and low-grade zinc-lead concentrates from the Goade mill at Granby shipped in 1941 totaled 1,277 tons.

OKLAHOMA

The method of marketing concentrates, prices quoted for them in 1941, and other general details of mining in the Tri-State region—which includes northeastern Oklahoma—are given in the preceding pages on Southwestern Missouri. Zinc and lead concentrates recovered from Oklahoma ores and old tailings had a combined value of $17,630,111, a 23-percent increase over 1940. The output of zinc concentrates increased 2 percent in quantity and lead concentrates 17 percent. About 120 mines produced during the year, and 27 mills were operating at the end of the year compared with 100 and 31, respectively, in 1940. Old tailings treated in Oklahoma in 1941 exceeded crude ore by 4,147,947 tons, and the tailings yielded 21 percent of the total zinc concentrates.

Mine shipments of lead and zinc in Oklahoma, 1937–41

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	39,446	$2,729,690	255,839	$10,428,354	29,840	$3,521,120	135,696	$17,640,480
1938	27,608	1,446,058	208,484	6,390,422	21,004	1,932,368	112,924	10,840,704
1939	36,422	2,189,077	258,214	8,937,554	27,720	2,605,680	140,379	14,599,416
1940	27,913	1,656,497	300,984	12,672,186	21,240	2,124,000	162,935	20,529,810
1941	32,628	2,202,876	307,207	15,427,235	25,021	2,852,394	166,602	24,990,300

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1940–41

	1940		1941	
	Crude Ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled.....short tons	4,195,400	7,055,000	4,868,021	9,015,968
Total concentrates produced:				
Galena.....do	27,328	585	32,296	332
Sphalerite.....do	238,806	62,178	243,773	63,434
Ratio of concentrates to ore, etc.:				
Lead.....percent	0 65	0.01	0.66	0.004
Zinc.....do	5.55	.88	5.01	.70
Metal content of ore, etc.: [1]				
Lead.....do	.51	004	.52	002
Zinc.....do	3 35	53	3.03	.41
Average lead content of galena concentrates..do	78.3	48.2	78.53	51.51
Average zinc content of sphalerite concentrates percent	60.3	59.6	60.59	58.97
Average value per ton:				
Galena concentrates	$59.75	$40.64	$67.75	$44.79
Sphalerite concentrates	42.40	40.95	50.55	48.94

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

The Eagle-Picher Mining & Smelting Co. continued to be the largest producer of both lead and zinc in Oklahoma and in the Tri-State region. The company Central mill near Cardin has a capacity of 13,000 tons daily and treats company and custom ore. New installations made in the mill in 1941 included a secondary differential-density cone to be used as a supplement to the primary cone unit, which has been in operation since February 1939, and eight sludge tables for separating a special blende product for shipment to the zinc oxide plant adjoining the company lead smelter at Galena, Kans. The total ore treated in 1941 was 3,311,144 tons compared with 2,795,963 tons in 1940. Company-operated mines in Oklahoma shipping to the mill were the Blue Goose mines, Crystal mines, Eagle-Picher Gordon Nos. 1 and 2, Grace Walker mines, Hum-bah-wat-tah mines, Jay Bird, John Beaver mines, Little Greenback, Ohimo, See Sah, Southside mines, Stanley, Swift, and Wesah Greenback. The principal shippers of Oklahoma custom ore were the Baird Mining Co. (American-Douthat), Cameron & Henderson (Admiralty, Kitty), Cortez-Childress, Davis-Big Chief Mining Co. (Eudora-Whitebird), F. W. Evans (Shorthorn, etc.), Jane E. Mining Co. (McKibben, Scott), Lula Bell Mining Co. (Anna Beaver), M. & M. Mining Co. (Piokee, Swift), and Mahutska Mining Co. (Acme). The Eagle-Picher 2,400-ton Bird Dog mill was shut down in April and remained idle the rest of the year.

The Gordon central mill of the Federal Mining & Smelting Co. treated company ore from the Gordon, Lucky Bill, Lucky Syndicate, and Quapaw-Davenport mines in Oklahoma and the Federal Jarrett in Kansas. The Beck Mining Co. mill treated company and custom ore. Evans Wallower Zinc, Inc., ran its No. 4 and No. 7 mines and mills steadily. The M. & W. Mining Co. mined and sent to the Bilharz mill in Kansas a considerable tonnage of ore of higher than average grade from the L. D. Brewster mine. Operation of the Woodchuck and Townsite mines and the Woodchuck mill in Oklahoma and the Cherokee mine in Kansas was taken over on December 12, 1941, by the Weidman Mining Co.; the Oklahoma Interstate Mining Co.,

which had operated them for many years, became inactive. The Skelton Lead & Zinc Co. closed its mill in December and began shipping to the Central mill. Other producers of concentrates from mine mills in Oklahoma comprised Kansas Explorations, Inc. (Ritz); Rialto Mining Corporation (No. 3 mill); Lawyers Lead & Zinc Co. (mine "dirt" and tailings); Lavrion Mining Co.; Lula Bell Mining Co.; Mission Mining & Royalty Co. (custom "dirt"); St. Louis Smelting & Refining Co. (No. 4 mill); United Zinc Smelting Corporation (company and custom ore); Davis-Big Chief Mining Co. (Kropp mine); Hudson Lead & Zinc Co. (Goodeagle); Guaranty Mining & Royalty Co.; Roan Bull Mining Co.; and Smoky Hill Mining Co.

Companies operating tailing mills in Oklahoma comprised the Atlas Milling Co., Big Chief Tailing Co., Britt & Britt Milling Co., Cardin Mining & Milling Co. (Nos. 2 and 3), Rialto Mining Corporation, C. Y. Semple, Tri-State Zinc, Inc. (Sooner and Ottawa), and Western Mining & Milling Co.

No production was reported in the Peoria area or the Davis (Murray County) district in 1941.

WISCONSIN

During the 10-year period ended with 1940 the annual output of recoverable zinc from Wisconsin averaged 7,295 tons and that of lead 607 tons; this comprised all the output of the Upper Mississippi Valley region except 6 tons of zinc and 8 tons of lead produced in Northern Illinois in 1940, as mines in Iowa yielded no zinc or lead from 1918 to 1941, inclusive. In 1941 mines in Wisconsin yielded 6,238 tons of zinc and 1,225 tons of lead and those in Northern Illinois 1,718 and 120 tons, respectively—a total for the Upper Mississippi Valley region of 7,956 tons of zinc and 1,345 tons of lead compared with 5,776 and 453 tons, respectively, in 1940.

Shipments of crude ore and zinc-iron-lead rougher jig concentrates to the Vinegar Hill Zinc Co. central flotation mill at Cuba City rose sharply during the latter part of 1941, necessitating a 50-percent enlargement in the capacity of the mill. The mill made zinc concentrates (averaging 59.50 percent zinc), lead concentrates, and iron sulfide concentrates that were roasted to produce sulfuric acid. The principal shippers of custom mine "dirt" to the mill were the McCabe Mining Co. and Strawberry Blonde Mining Co. in the Benton district; the Depp Mining Co., Cuba City; the Meloy & Baker Mining Co., New Diggings; Arensdorf & Murray and the St. Joe Mining Co., Platteville; and Gill Brothers, Northern Illinois. Shippers of jig mill concentrates were the Big Jack Mining Co., Platteville; C. F. & H. Mining Co., New Diggings; Cuba Mining Co., Shullsburg; Four S. & B. Mining Co., Dodgeville; and Little Benny Mining Co., New Diggings. The Vinegar Hill Zinc Co. closed its Mullen No. 2 mine in April. The Dodgeville Mining Co. operated its 150-ton jig mill and 50-ton flotation mill (placed in operation December 20, 1940) throughout 1941; the zinc concentrates made in the flotation mill averaged 61.24 percent zinc. Several cars of zinc carbonate were shipped from the Clark No. 2 mine in the Highland district.

Mine production of lead and zinc in Wisconsin, 1937–41

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	1,590	$109,468	37,060	$444,531	1,091	$128,738	6,938	$901,940
1938	493	21,050	[2] 3,895	[2] 121,180	320	29,440	2,073	199,008
1939	567	29,327	[3] 10,169	[3] 355,915	388	36,472	5,904	614,016
1940	621	34,852	[3] 10,875	[3] 447,396	445	44,500	5,770	727,020
1941	1,639	111,014	[3] 11,685	[3] 594,323	1,225	139,650	6,238	935,700

[1] In calculating metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc In comparing the values of ores and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades

[2] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.

[3] Most of the ore mined in Wisconsin from 1939–41 was first treated in gravity-concentration mills producing bulk concentrates which were re-treated by flotation A considerable quantity of crude ore was floated direct.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1937–41

	1937	1938	1939	1940	1941
Total ore...short tons..	285,000	58,700	213,400	190,326	211,973
Total concentrates in ore.					
Lead...percent .	0 56	0 84	0 26	0 33	0.77
Zinc...do...	13.00	[1] 22 15	[2] 15 15	[3] 5 71	[3] 5.51
Metal content of ore. [4]					
Lead...do..	29	55	19	24	59
Zinc...do...	3 12	3.91	3 07	3.37	3 27
Average lead content of galena concentrates...do...	70 1	67.0	70.0	73 1	76.27
Average zinc content of sphalerite concentrates percent..	24.0	18 5	20.2	[3] 58 94	[3] 59.77
Average value per ton·					
Galena concentrates...	$68.85	$42 70	$51.72	$56.12	$67.73
Sphalerite concentrates...	11 99	[5] 31 11	[6] 35 00	[6] 41 14	[6] 51.39

[1] The zinc concentrates shipped in 1938 (3,895 tons) were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938, about 13,000 tons, averaging 18 5 percent zinc, were produced.

[2] All sphalerite shipped in 1939 (10,169 tons) was a flotation product No raw concentrates were shipped in 1939; 32,360 tons, averaging 20 2 percent zinc, were produced.

[3] Percentage represents finished flotation concentrates Most of the ore mined in Wisconsin in 1940 and 1941 was first treated in gravity-concentration mills producing bulk concentrates which were re-treated by flotation. A considerable quantity of crude ore was floated direct

[4] Percentages represent metal content of the ore insofar as it is recovered in the concentrates.

[5] Value is that of roasted or flotation concentrates shipped. No value can be assigned for zinc concentrates prior to roasting or re-treatment by flotation.

[6] Value is that of flotation concentrates shipped

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

SUMMARY

Colorado mines yielded gold, silver, copper, lead, and zinc valued, in terms of recovered metals, at $23,877,597 in 1941 compared with $24,293,665 in 1940. (See fig. 1.) Gold and silver together represented 77 percent of the total value in 1941 and 81 percent in 1940. Gold production increased 3 percent over 1940 and was the highest since 1924. The quantity of silver and copper produced decreased 25 and 44 percent, respectively, lead increased 10 percent, and zinc increased 211 percent. The output of zinc was 31,444,000 pounds, compared with 10,120,000 pounds in 1940 and with an annual average of 3,792,250 pounds in the 8-year period from 1932 to 1939. The number of large producing lode mines was about the same as in 1940; the number of placer operations (large and small) decreased, but the entire gain in gold production of the State came from the placers.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35 00	$0.7735	$0 121	$0 059	$0 065
1938	35.00	[4].646+	098	046	048
1939	35 00	[5] 678+	104	047	.052
1940	35.00	[6] 711+	113	050	063
1941	35 00	[6] 711+	118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934 Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938–41· Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

Annual figures for the 5 years ended with 1941 and total production from 1858 to 1941 are given in the table that follows. Colorado has produced more silver in the past than any other State and ranks second in total recorded output of gold.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1937–41, and total, 1858–1941, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	655	490	2,068,619	368,905	$12,911,675	6,260,693	$4,842,646
1938	669	592	1,996,095	367,468	12,861,380	7,932,095	5,127,819
1939	758	583	1,914,593	366,852	12,839,820	8,496,488	5,767,313
1940	691	439	2,157,765	367,336	12,856,760	9,710,709	6,905,393
1941	579	324	2,222,786	380,029	13,301,015	7,301,697	5,192,318
1858–1941			(1)	38,296,755	834,263,389	717,950,564	558,481,176

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	21,868,000	$2,646,028	19,572,000	$1,154,748	8,494,000	$552,110	$22,107,207
1938	28,342,000	2,777,516	18,910,000	869,860	9,106,000	437,088	22,073,663
1939	26,430,000	2,748,720	16,444,000	772,868	3,660,000	190,320	22,319,041
1940	24,304,000	2,746,352	22,952,000	1,147,600	10,120,000	637,560	24,293,665
1941	13,496,000	1,592,528	25,148,000	1,433,436	31,444,000	2,358,300	23,877,597
1858–1941	(2) 244,294	64,499,199	(2) 2,376,891	224,695,713	(2) 1,151,014	161,586,696	1,843,526,173

(1) Figures not available.
(2) Short tons.

Gold and silver produced at placer mines in Colorado, 1937–41, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land (1)		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1937	1,948 21	401	2,020 13	411	6,212 24	1,033	2,780 35	286	1,910 07	434	14,871 00	2,565
1938	2,285 00	433	1,362.00	279	10,201 00	2,020	3,166.00	279	1,027 00	239	18,041.00	3,250
1939	2,535 00	498	15.00	1	10,631 00	2,436	1,950.00	178	4,688.00	1,012	19,819 00	4,125
1940	1,822 00	360			10,203 00	2,210			4,975.00	1,068	17,000 00	3,638
1941	1,886 00	402			13,052 00	2,580	4,817 00	553	10,622.00	2,152	30,377 00	5,687

(1) Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—The output of gold from lode mines in Colorado in 1941 varied little from 1940, but that from placer mines increased 13,377 ounces (79 percent), owing mainly to production from new dredging operations in Park County. The Cripple Creek district, Teller County, continued to be the principal gold-producing district in the State; it was followed, in order, by the Red Cliff district, Eagle County; Upper San Miguel, San Miguel County; Mosquito, Park County; Leadville, Lake County; Animas, San Juan County; Summitville, Rio Grande County; Empire, Clear Creek County; Southern districts, Gilpin County; Idaho Springs, Clear Creek County; Gold Hill,

Boulder County; Sneffels, Ouray County; and Fairplay, Park County. Each of these districts yielded more than 10,000 ounces of gold. The largest gains over 1940, by counties, were 10,137 ounces in Lake County, 7,270 ounces in Park, 4,538 ounces in Teller, 4,344 ounces in Gilpin, and 4,342 ounces in Rio Grande; the largest decreases were 6,005 ounces in Eagle County, 5,084 ounces in Clear Creek, 3,246 ounces in San Miguel, and 2,892 ounces in Boulder. Dry and siliceous ores yielded 80 percent of the total gold; copper ore, 7 percent; zinc-lead, lead, zinc, and lead-copper ores, 5 percent; and placers, 8 percent.

Silver.—The mine production of silver in Colorado was 7,301,697 ounces in 1941—a decrease of 2,409,012 ounces from 1940. Eagle County continued to be by far the largest producer of silver in the State, although its output decreased from 6,766,726 ounces in 1940 to 4,352,677 ounces in 1941. Variations in output in other important silver-producing counties were decreases of 32,906 ounces in Clear Creek County, 13,247 ounces in Dolores, 90,744 ounces in Ouray, 27,852 ounces in Pitkin, and 18,499 ounces in San Miguel and increases of 39,340 ounces in Lake County, 40,310 ounces in Mineral, and 170,069 ounces in San Juan. Copper ore yielded 59 percent of the total silver; dry and siliceous ores 30 percent; and other types of ore, with a very small quantity of silver from placer mines, 11 percent.

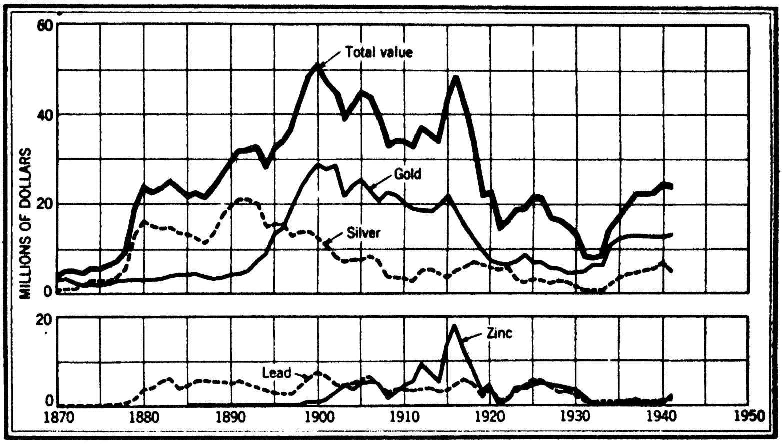

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1941. The value of copper has been less than $2,000,000 annually, except in a few years.

Copper.—The mine output of recoverable copper in Colorado was 13,496,000 pounds in 1941 compared with 24,304,000 pounds in 1940. The only sizable producer of copper in the State in either year was the Empire Zinc Division "Eagle Mine" of the New Jersey Zinc Co. at Gilman, Eagle County, which continued to ship copper-iron-silver-gold-lead ore direct to the copper smelter at Garfield, Utah. About June 15, 1941, the company began also to mine and mill zinc-lead ore in quantity, with greatly decreased output of copper-bearing ore. The copper output from other counties in the State came chiefly from zinc-lead ore and dry and siliceous ore; those that contributed more than 100,000 pounds of recoverable copper during the year were Boulder, Clear Creek, Dolores, Gilpin, Jefferson, Lake, Ouray, and San Juan.

Lead.—The mine production of lead in Colorado was 25,148,000 pounds in 1941 compared with 22,952,000 pounds in 1940. The output in 1941 came chiefly from San Juan, Dolores, Eagle, San Miguel, Lake, and Mineral Counties, each of which contributed more than 1,000,000 pounds. Zinc-lead ore yielded 53 percent of the total lead; dry and siliceous ore, 32 percent; and lead, copper, zinc, and lead-copper ores together, 15 percent.

Zinc.—Mines in Colorado yielded 31,444,000 pounds of recoverable zinc in 1941 compared with 10,120,000 pounds in 1940. The large increase in 1941 resulted from resumption of the mining and milling of zinc-lead ore by the New Jersey Zinc Co. Empire Zinc Division at its Eagle mine at Gilman, Eagle County. From 1932 to 1940, inclusive, the zinc-lead ore bodies in this mine were not worked, and the 600-ton underground flotation mill was idle. The total output of zinc from other mines in Colorado decreased slightly from 1940; and the principal producers in both years were the Rico Argentine Mining Co. at Rico, Dolores County, and the Shenandoah-Dives Mining Co. at Silverton, San Juan County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams		3	282	$9,870	45	$32
Arapahoe		1	22	770	4	3
Archuleta	1		38	1,330	4	3
Boulder	99	4	30,729	1,075,515	62,775	44,640
Chaffee	12	15	498	17,430	1,734	1,233
Clear Cr:ek	77	16	33,198	1,161,930	129,416	92,029
Conejos	1		7	245	204	145
Costilla	1	1	7	245	1	1
Custer	3				2,222	1,580
Denver		3	6	210		
Dolores	5		1,068	37,380	150,477	107,006
Douglas		6	13	455		
Eagle	5	1	25,168	880,880	4,352,677	3,095,237
Fremont	2		1	35	35	25
Garfield	4		89	3,115	142	101
Gilpin	51	80	13,560	474,600	17,966	12,776
Grand	3		1	35	744	529
Gunnison	19		1,871	65,485	13,815	9,824
Hinsdale	5		20	700	6,186	4,399
Jefferson	1	26	579	20,265	2,039	1,450
Lake	45	18	20,287	710,045	120,603	85,762
La Plata	6	1	747	26,145	1,914	1,361
Larimer	2		31	1,085	21	15
Mineral	6		904	31,640	906,712	644,773
Montezuma	2		1,112	38,920	1,229	874
Montrose	1	18	56	1,960	13,735	9,767
Ouray	17		10,790	377,650	159,186	113,199
Park	21	75	45,682	1,598,870	31,230	22,208
Pitkin	5				238,773	169,794
Rio Grande	1		16,979	594,265	14,019	9,969
Routt		2	5	175	3	2
Saguache	9		24	840	17,706	12,591
San Juan	25		17,384	608,440	532,731	378,831
San Miguel	21	2	24,097	843,395	450,515	320,366
Summit	30	52	1,304	45,640	51,234	36,433
Teller	99		133,470	4,671,450	21,600	15,360
	579	324	380,029	13,301,015	7,301,697	5,192,318
Total, 1940	691	439	367,336	12,856,760	9,710,709	6,905,393

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1941, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$9,902
Arapahoe							773
Archuleta							1,333
Boulder	103,000	$12,154	225,000	$12,825	11,000	$825	1,145,959
Chaffee	3,000	354	28,000	1,596	48,000	3,600	24,213
Clear Creek	181,000	21,358	947,000	53,979	112,000	8,400	1,337,696
Conejos							390
Costilla			4,000	228	8,000	600	1,074
Custer	2,000	236	66,000	3,762			5,578
Denver							210
Dolores	124,000	14,632	5,054,000	288,078	6,008,000	450,600	897,696
Douglas							455
Eagle	11,218,000	1,323,724	3,420,000	194,940	21,760,000	1,632,000	7,126,781
Fremont	8,000	944	2,000	114			1,118
Garfield	500	59			7,000	525	3,800
Gilpin	138,000	16,284	39,000	2,223			505,883
Grand			2,000	114			678
Gunnison	3,000	354	120,000	6,840	64,000	4,800	87,303
Hinsdale	15,000	1,770	15,000	855			7,724
Jefferson	192,000	22,656					44,371
Lake	102,000	12,036	2,230,000	127,110	95,000	7,125	942,078
La Plata							27,506
Larimer							1,100
Mineral	32,000	3,776	1,140,000	64,980			745,169
Montezuma							39,794
Montrose	47,000	5,546					17,273
Ouray	256,000	30,208	637,000	36,309	38,000	2,850	560,216
Park	79,000	9,322	738,000	42,066	614,000	46,050	1,718,516
Pitkin	2,000	236	807,000	45,999	254,000	19,050	235,079
Rio Grande	8,000	944					605,178
Routt							177
Saguache	26,000	3,068	320,000	18,240	62,000	4,650	39,389
San Juan	870,000	102,660	6,145,000	350,265	1,680,000	126,000	1,566,196
San Miguel	78,500	9,263	2,834,000	161,538			1,334,562
Summit	8,000	944	375,000	21,375	683,000	51,225	155,617
Teller							4,686,810
	13,496,000	1,592,528	25,148,000	1,433,436	31,444,000	2,358,300	23,877,597
Total, 1940	24,304,000	2,746,352	22,952,000	1,147,600	10,120,000	637,560	24,293,665

Ore sold or treated and gold and silver produced at lode mines in Colorado in 1941, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Archuleta	7	38	4
Boulder	89,958	30,719	62,775
Chaffee	221	207	1,689
Clear Creek	179,434	32,372	129,316
Conejos	45	7	204
Costilla	46		
Custer	178		2,222
Dolores	48,827	1,068	150,477
Eagle	328,655	25,164	4,352,677
Fremont	33	1	35
Garfield	100	89	142
Gilpin	28,778	8,320	17,038
Grand	15	1	744
Gunnison	9,638	1,871	13,815
Hinsdale	707	20	6,186
Jefferson	4,624	151	1,959
Lake	243,902	19,270	120,285
La Plata	134	744	1,914
Larimer	15	31	21
Mineral	41,568	904	906,712
Montezuma	2,558	1,112	1,229
Montrose	270	2	13,718
Ouray	44,148	10,790	159,186
Park	112,799	24,415	27,343
Pitkin	24,088		238,773
Rio Grande	27,313	16,979	14,019
Saguache	1,415	24	17,706
San Juan	265,232	17,384	532,731

Ore sold or treated and gold and silver produced at lode mines in Colorado in 1941, by counties, in terms of recovered metals—Continued

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
San Miguel	234,830	24,089	450,512
Summit	4,607	410	50,978
Teller	528,641	133,470	21,600
	2,222,786	349,652	7,296,010
Total, 1940	2,157,765	350,336	9,707,071

Gold and silver produced at placer mines in Colorado in 1941, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dredges						Total	
			Dry-land [1]		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Adams	282	45							282	45
Arapahoe	22	4							22	4
Boulder	7		3						10	
Chaffee	115	18	176	27					291	45
Clear Creek	12	1	814	99					826	100
Costilla	7	1							7	1
Denver	6								6	
Douglas	13								13	
Eagle	4								4	
Gilpin	189	42	5,051	886					5,240	928
Jefferson	428	80							428	80
Lake	315	90	702	228					1,017	318
La Plata	3								3	
Montrose	54	17							54	17
Park	204	43	5,624	1,139	4,817	553	10,622	2,152	21,267	3,887
Routt	5	3							5	3
San Miguel	8	3							8	3
Summit	212	55	682	201					894	256
	1,886	402	13,052	2,580	4,817	553	10,622	2,152	30,377	5,687
Total, 1940	1,822	360	10,203	2,210			4,975	1,068	17,000	3,638

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

In 1941 the output of dry and siliceous gold, gold-silver, and silver ores from mines and dumps in Colorado increased 3 percent and zinc-lead ore 53 percent over 1940, whereas copper ore decreased 38 percent and lead ore 22 percent. This sharp variation from 1940 in the State total output of zinc-lead and copper ores is explained by the fact that in 1940 the output of the Eagle mine in Eagle County, largest producer of copper and silver in the State since 1930, consisted entirely of copper ore (carrying iron, gold, silver, and lead), whereas in 1941, although the total tonnage was approximately the same as in 1940, part of the output was copper ore and part zinc-lead ore. The total quantity of zinc-lead ore mined in other counties in the State increased 9 percent. The increase in output of dry and siliceous ores in 1941 came from the Ibex dumps in Lake County. In July 1941 the Golden Cycle Corporation completed the driving of the 32,262-foot Carlton drainage tunnel in the Cripple Creek district, permitting renewal of mining on the lower levels of the Ajax and Cresson mines. The Resurrection Mining Co. at Leadville continued development work at its property and nearly completed construction

of a 250-ton zinc-lead flotation mill; the mill was placed in operation February 1, 1942. The South Platte Dredging Co. completed and put in operation its new floating connected-bucket dredge on the Platte River near Fairplay, and Cooley Bros. installed and operated a dragline floating dredge near Como.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Colorado in 1941, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	1, 234, 025	277, 160	401, 609	797, 207	2, 422, 510	
Dry and siliceous gold-silver ore	270, 267	27, 067	622, 763	141, 481	3, 581, 952	
Dry and siliceous silver ore	68, 471	967	1, 200, 260	42, 690	2, 003, 656	254, 000
	1, 572, 763	305, 194	2, 224, 632	981, 378	8, 008, 118	254, 000
Copper ore	207, 678	25, 187	4, 306, 343	11, 479, 396	1, 678, 029	
Lead ore	7, 917	1, 455	73, 496	30, 392	2, 165, 829	
Lead-copper ore	4	4	442	339	618	
Zinc ore	224	77	756	2, 400	6, 153	107, 071
Zinc-lead ore	434, 200	17, 735	690, [illegible]41	1, 002, 095	13, 289, 253	31, 082, 929
	650, 023	44, 458	5, 071, 378	12, 514, 622	17, 139, 882	31, 190, 000
Total, lode mines	2, 222, 786	349, 652	7, 296, 010	13, 496, 000	25, 148, 000	31, 444, 000
Total, placers		30, 377	5, 687			
	2, 222, 786	380, 029	7, 301, 697	13, 496, 000	25, 148, 000	31, 444, 000
Total, 1940	2, 157, 765	367, 336	9, 710, 709	24, 304, 000	22, 952, 000	10, 120, 000

METALLURGIC INDUSTRY

Ore treated in 1941 by all mills in Colorado handling ores of gold, silver, copper, lead, and zinc totaled 1,970,253 tons, of which 1,379,077 tons were treated in company mills at mines and dumps; 532,127 tons by the Golden Cycle custom roast-amalgamation-cyanidation-flotation mill at Colorado Springs; and 59,049 tons by the following custom concentration mills (some of which also treated company ore included above) in or near the mining districts: Orphan Boy in Boulder County; Black Eagle, Clear Creek-Gilpin, Red Elephant, Ruth, and Watrous (Silver Leaf) in Clear Creek County; Eldorado in Hinsdale County; Creede Mills (Emperius) in Mineral County; Banner American in Ouray County; Record in Park County; Shenandoah-Dives in San Juan County; Smuggler-Union in San Miguel County; and Cameron in Teller County. All these custom mills except the Shenandoah-Dives and Banner American treated gold, gold-silver, or silver ores, with a minor content of lead and copper. Zinc-lead ore (4,913 tons) containing gold and silver and some copper, from Boulder, Chaffee, Dolores, Gunnison, Lake, Ouray, Saguache, San Juan, and Summit Counties, was shipped to custom mills at Bauer, Midvale, and Tooele, Utah. The ore-sampling works at Boulder was run part of 1941; the sampler at Idaho Springs was idle throughout the year.

Direct-smelting ores comprised 11 percent of the State total output of ore in 1941. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the gold, silver, and gold-silver-lead-copper ores and concentrates shipped to smelters during the year. Ore and concentrates were shipped to smelters in other States as

follows: Zinc-lead sulfide ores and concentrates from Lake, Saguache, and Summit Counties to Coffeyville, Kans.; zinc concentrates from Clear Creek, Dolores, Ouray, Park, Pitkin, San Juan, and Summit Counties to Amarillo, Tex.; and copper-iron-silver-gold ore from Eagle County, copper-silver and copper-silver-gold ores and concentrates from Custer, Garfield, Jefferson, Larimer, and Montrose Counties, and gold-silver-lead-copper ores and concentrates from the San Juan region to Utah smelters.

The quantity of gravel handled in 1941 by 2 floating connected-bucket dredges, 1 dragline floating dredge, and 31 dry-land dredges was approximately 5,322,300 cubic yards averaging 18.74 cents to the yard. Specific data on yardage handled at small-scale placer operations are not obtainable because of lack of knowledge by the operators of the quantity of gravel sluiced.

Mine production of metals in Colorado in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore and concentrates amalgamated [1]	1,040,093	78,933	18,513			
Ore, old tailings, concentrates, sands, and slimes cyanided [2]	[3] 578,261	124,258	35,101			
Concentrates smelted	106,124	111,198	2,404,131	2,110,994	20,199,890	31,404,929
Ore smelted	247,620	35,263	4,838,265	11,385,006	4,948,110	39,071
Placer [1]		30,377	5,687			
		380,029	7,301,697	13,496,000	25,148,000	31,444,000
Total, 1940		367,336	9,710,709	24,304,000	22,952,000	10,120,000

[1] Quicksilver used by amalgamation mills was 3,489 pounds. Placer mines used approximately 550 pounds

[2] Cyanide (in terms of 96- to 98-percent NaCN) used was 641,045 pounds.

[3] Comprises 355,349 tons of sands and slimes from ore and iron concentrates first roasted and amalgamated, 176,778 tons of tailings from ore first floated, 26,483 tons of tailings from ore first treated by jigging, and 19,651 tons of combined flotation concentrates, crude ore, and old tailings cyanided direct.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1941, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Boulder	69,616	20,271	6,022	2,835	4,949	22,602	49,834	130,942
Chaffee	16	15	15					
Clear Creek	149,447	15,918	3,728	4,270	8,715	49,945	44,423	482,756
Conejos	45	7	204					
Eagle	(1)	2						
Garfield	3	6						
Gilpin	16,197	1,409	346	1,065	1,626	6,889	24,215	18,622
Gunnison	8,617	1,400	809	125	275	5,899		8,148
Lake	224,736	8,934	2,993	6,006	7,074	61,193	94,181	425,188
Larimer	7	14	14					
Montezuma	2,510	791	220	24	84	564		
Ouray	38,654	7,604	1,817	3,155	2,944	118,057	245,916	445,602
Park	18,249	322	119	949	2,395	3,726	2,838	84,961
Rio Grande	27,313	10,699	11,816	830	6,280	2,203	8,000	
San Juan	.5	19	99					
San Miguel	194,161	7,356	6,721	13,768	14,108	325,680		1,887,604
Summit	11	6	3					
Teller	494,587	128,418	18,688					
	1,244,184	203,191	53,614	33,027	48,450	596,758	469,407	3,483,823
Total, 1940	1,225,741	196,735	67,509	37,230	53,339	658,370	849,941	4,288,072

[1] Less than ½ ton.

Mine production of metals from concentrating mills in Colorado in 1941, by counties, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	18,841	588	3,173	28,947	10,371	78,782	11,000
Chaffee	125	80	59	645	2,067	12,277	48,000
Clear Creek	29,585	4,612	7,498	56,959	125,128	381,624	112,000
Dolores	48,812	11,259	1,067	150,209	123,593	5,042,104	6,008,000
Eagle	125,311	27,311	163	63,941	10,354	1,746,612	21,760,000
Garfield	26	7	----	83	----	----	7,000
Gilpin	12,265	1,855	4,020	7,767	95,520	6,570	----
Gunnison	896	209	143	3,374	2,900	65,773	64,000
Hinsdale	616	72	13	1,682	11,904	6,923	----
Jefferson	4,624	884	151	1,959	192,000	----	----
Lake	2,586	293	107	3,460	495	67,758	85,903
La Plata	25	5	11	159	----	----	----
Mineral	34,370	2,316	644	580,959	32,000	648,000	----
Ouray	4,908	250	28	24,111	5,860	141,035	38,000
Park	94,235	5,693	20,941	22,150	73,967	623,980	614,000
Pitkin	10,200	898	----	180,471	1,622	560,420	254,000
Saguache	501	170	5	1,768	2,644	52,152	62,000
San Juan	265,001	10,656	17,060	530,941	866,819	6,131,382	1,680,000
San Miguel	40,498	3,185	2,546	115,330	76,500	928,960	----
Summit	3,504	1,251	81	29,548	7,843	221,715	661,026
Teller	34,053	1,503	5,038	2,910	----	----	----
	730,982	73,097	62,748	1,807,373	1,641,587	16,716,067	31,404,929
Total, 1940	550,732	42,394	55,194	1,674,971	2,151,162	13,024,734	9,838,578

BY CLASSES OF ORE TREATED

Dry and siliceous gold	178,799	12,480	39,551	78,245	271,838	783,487	----
Dry and siliceous gold-silver	67,203	5,027	4,568	256,103	133,785	1,333,098	----
Dry and siliceous silver	45,729	3,305	649	775,644	38,579	1,224,756	254,000
Copper	4,624	884	151	1,959	192,000	----	----
Lead	311	120	17	4,325	890	87,173	----
Zinc	162	87	77	756	2,400	2,300	76,000
Zinc-lead	434,154	51,194	17,735	690,341	1,002,095	13,285,253	31,074,929
	730,982	73,097	62,748	1,807,373	1,641,587	16,716,067	31,404,929

Gross metal content of concentrates produced from ores mined in Colorado in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	18,515	36,210	142,794	334,215	841,742	515,277
Dry gold-silver	998	1,313	46,700	1,386	34,461	27,436
Dry silver	105	12	6,107	1,971	6,762	47,290
Copper	2,549	4,297	13,884	392,594	16,436	34,122
Lead	40,500	57,509	1,752,072	458,566	18,016,530	4,149,100
Lead-copper	7,253	11,550	396,782	1,206,460	3,011,694	1,449,751
Total to copper and lead plants	69,920	110,891	2,358,339	2,395,192	21,927,625	6,222,970
Zinc	36,204	430	66,899	185,751	614,636	35,272,832
	106,124	111,321	2,425,238	2,580,943	22,542,261	41,495,808
Total, 1940	79,624	108,688	2,350,225	3,582,869	19,632,705	17,168,976

Mine production of metals from Colorado concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	3,423	8,122	51,549	60,205	209,724	11,000
Chaffee	80	59	645	2,067	12,277	48,000
Clear Creek	8,882	16,213	106,904	169,551	864,380	112,000
Dolores	11,259	1,067	150,209	123,593	5,042,104	6,008,000
Eagle	27,311	163	63,941	10,354	1,746,612	21,760,000
Garfield	7	------	83	------	------	7,000
Gilpin	2,920	5,646	14,656	119,735	25,192	------
Gunnison	334	418	9,273	2,900	73,921	64,000
Hinsdale	72	13	1,682	11,904	6,923	------
Jefferson	884	151	1,959	192,000	------	------
Lake	6,299	7,181	64,653	94,676	492,946	85,903
La Plata	5	11	159	------	------	------
Mineral	2,316	644	580,959	32,000	648,000	------
Montezuma	24	84	564	------	------	------
Ouray	3,405	2,972	142,168	251,776	586,637	38,000
Park	6,642	23,336	25,876	76,805	708,941	614,000
Pitkin	898	------	180,471	1,622	560,420	254,000
Rio Grande	830	6,280	2,203	8,000	------	------
Saguache	170	5	1,768	2,644	52,152	62,000
San Juan	10,656	17,060	530,941	866,819	6,131,382	1,680,000
San Miguel	16,953	16,654	441,010	76,500	2,816,564	------
Summit	1,251	81	29,548	7,843	221,715	661,026
Teller	1,503	5,038	2,910	------	------	------
	106,124	111,198	2,404,131	2,110,994	20,199,890	31,404,929
Total, 1940	79,624	108,533	2,333,341	3,001,103	17,312,806	9,838,578

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	18,515	36,210	142,794	266,862	757,006	------
Dry gold-silver	998	1,313	46,700	1,031	29,824	------
Dry silver	105	12	6,107	1,513	6,216	------
Copper	2,549	4,297	13,884	347,968	14,617	------
Lead	40,500	57,509	1,752,072	365,322	16,268,071	------
Lead-copper	7,253	11,550	396,782	978,768	2,737,848	------
Total to copper and lead plants	69,920	110,891	2,358,339	1,961,464	19,813,582	------
Zinc	36,204	307	45,792	149,530	386,308	31,404,929
	106,124	111,198	2,404,131	2,110,994	20,199,890	31,404,929

Gross metal content of Colorado crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	8,782	7,611	22,471	75,731	170,039	13,569
Dry and siliceous gold-silver	5,324	856	17,181	2,473	279,942	3,277
Dry and siliceous silver	22,742	318	424,616	5,862	865,307	9,541
Copper	203,054	25,036	4,304,384	11,583,589	2,794,753	4,053,197
Lead	7,606	1,438	69,171	37,268	2,303,947	142,569
Lead-copper	4	4	442	424	686	------
Total to copper and lead plants	247,512	35,263	4,838,265	11,705,347	6,414,674	4,222,153
Zinc	62	------	------	------	5,166	37,989
Zinc-lead	46	------	------	------	4,639	10,021
Total to zinc plants	108	------	------	------	9,805	48,010
	247,620	35,263	4,838,265	11,705,347	6,424,479	4,270,163
Total, 1940	381,292	45,068	7,306,221	22,044,508	8,136,711	5,451,929

Mine production of metals from Colorado crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Archuleta	7	38	4			
Boulder	1, 501	2, 326	5, 204	42, 795	15, 276	
Chaffee	80	133	1, 029	933	15, 723	
Clear Creek	402	241	18, 684	11, 449	82, 620	
Costilla	46				4, 000	8, 000
Custer	178		2, 222	2, 000	66, 000	
Dolores	15	1	268	407	11, 896	
Eagle	203, 344	24, 999	4, 288, 736	11, 207, 646	1, 673, 388	
Fremont	33	1	35	8, 000	2, 000	
Garfield	71	83	59	500		
Gilpin	316	1, 265	2, 036	18, 265	13, 808	
Grand	15	1	744		2, 000	
Gunnison	125	53	3, 733	100	46, 079	
Hinsdale	91	7	4, 504	3, 096	8, 077	
Lake	16, 580	3, 155	52, 639	7, 324	1, 737, 054	9, 097
La Plata	109	733	1, 755			
Larimer	8	17	7			
Mineral	7, 198	260	325, 753		492, 000	
Montezuma	48	237	445			
Montrose	270	2	13, 718	47, 000		
Ouray	586	214	15, 201	4, 224	50, 363	
Park	315	757	1, 348	2, 195	29, 059	
Pitkin	13, 888		58, 302	378	246, 580	
Saguache	914	19	15, 938	23, 356	267, 848	
San Juan	216	305	1, 691	3, 181	13, 618	
San Miguel	171	79	2, 781	2, 000	17, 436	
Summit	1, 092	323	21, 427	157	153, 285	21, 974
Teller	1	14	2			
	247, 620	35, 263	4, 838, 265	11, 385, 006	4, 948, 110	39, 071
Total, 1940	381, 292	45, 068	7, 306, 221	21, 302, 897	5, 639, 194	281, 422

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	8, 782	7, 611	22, 471	61, 792	152, 793	
Dry and siliceous gold-silver	5, 324	856	17, 181	1, 866	251, 261	
Dry and siliceous silver	22, 742	318	424, 616	4, 111	778, 900	
Copper	203, 054	25, 036	4, 304, 384	11, 287, 396	1, 678, 029	
Lead	7, 606	1, 438	69, 171	29, 502	2, 078, 656	
Lead-copper	4	4	442	339	618	
Total to copper and lead plants	247, 512	35, 263	4, 838, 265	11, 385, 006	4, 940, 257	
Zinc	62				3, 853	31, 071
Zinc-lead	46				4, 000	8, 000
Total to zinc plants	108				7, 853	39, 071
	247, 620	35, 263	4, 838, 265	11, 385, 006	4, 948, 110	39, 071

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Adams County		3			282	282		45	45				$9,902
Arapahoe County		1			22	22		4	4				773
Archuleta County	1		7	38		38	4		4				1,333
Boulder County:													
Central	13		13,498	7,753		7,753	2,936		2,936	300	14,600	7,000	274,835
Gold Hill	32	3	45,470	12,601	7	12,608	24,701		24,701	50,000	130,700		472,195
Grand Island	9	1	16,953	2,898	3	2,901	25,851		25,851	2,900	73,600	4,000	124,755
Magnolia	8		1,664	960		960	388		388				33,876
Sugar Loaf	26		7,114	3,662		3,662	5,493		5,493	600	4,700		132,415
Ward	11		5,259	2,845		2,845	3,406		3,406	49,200	1,400		107,883
Chaffee County:													
Chalk Creek	2		98	130		130	641		641	1,600	20,800	18,000	7,731
Four Mile	1		67	39		39	336		336	1,000	1,200	30,000	4,040
Granite [1]	3	15	10	8	291	299	10	45	55				10,504
La Plata	1		2	3		3	3		3		300		124
Monarch	2		28	13		13	682		682	400	5,700		1,312
Red Mountain	1		2	2		2	3		3				72
Turret	2		14	12		12	14		14				430
Clear Creek County:													
Alice	6		1,178	473		473	772		772	1,000	14,000		18,020
Argentine	3		3,770	53		53	21,614		21,614	2,100	43,000		19,924
Empire	8		74,173	14,612		14,612	6,445		6,445	68,500	300		524,103
Griffith	6		739	42		42	10,908		10,908	500	67,000	112,000	21,505
Idaho Springs [2]	42	16	67,997	11,959	826	12,785	75,548	100	75,648	106,700	549,000		545,153
Montana	2		175	8		8	6,895		6,895	300	77,000		9,607
Trail Creek	10		31,402	5,225		5,225	7,134		7,134	1,900	196,700		199,384
Conejos County	1		45	7		7	204		204				390
Costilla County	1	1	46		7	7		1	1		4,000	8,000	1,074
Custer County	3		178				2,222		2,222	2,000	66,000		5,578
Denver County		3			6	6							210
Dolores County:													
Lone Cone	1		11,201	966		966	37,762		37,762		4,300		60,908
Pioneer (Rico)	4		37,626	102		102	112,715		112,715	124,000	5,049,700	6,008,000	836,788
Douglas County. Newlin Gulch		6			13	13							455
Eagle County:													
Mount Egley	1	1	(3)	2	4	6							210
Red Cliff	4		328,655	25,162		25,162	4,352,677		4,352,677	11,218,000	3,420,000	21,760,000	7,126,571
Fremont County	2		33	1		1	35		35	8,000	2,000		1,118
Garfield County: Rifle Creek	4		100	89		89	142		142	500		7,000	3,800

Gilpin County:													
Southern	43	76	26,043	7,956	5,134	13,090	16,723	918	17,641	138,000	38,000		489,145
Northern	8	4	2,735	364	106	470	315	10	325		1,000		16,738
Grand County	3		15	1		1	744		744		2,000		678
Gunnison County.													
Domingo	1		1				3		3	100			14
Gold Brick	7		9,297	1,822		1,822	7,581		7,581		26,400		70,666
Green Mountain	2		7	4		4	7		7				145
Quartz Creek	3		15	3		3	464		464		2,400		572
Rock Creek	2		7	2		2	862		862		200	1,000	769
Taylor Park (Tin Cup)	3		219	38		38	4,095		4,095	2,900	58,400	28,000	10,013
Tomichi	1		92	2		2	803		803		32,600	35,000	5,124
Hinsdale County													
Galena	3		623	13		13	1,776		1,776	12,000	11,000		3,761
Lake	2		84	7		7	4,410		4,410	3,000	4,000		3,963
Jefferson County	1	26	4,624	151	428	579	1,959	80	2,039	192,000			44,371
Lake County:													
California (Leadville)	38	14	240,219	19,037	309	19,346	114,016	87	114,103	101,800	2,224,300	95,000	904,172
Other districts [4]	7	4	3,683	233	708	941	6,269	231	6,500	200	5,700		37,906
La Plata County. California	6	1	134	744	3	747	1,914		1,914				27,506
Larimer County.													
Manhattan	1		8	17		17	7		7				600
Masonville	1		7	14		14	14		14				500
Mineral County: Creede	6		41,568	904		904	906,712		906,712	32,000	1,140,000		745,169
Montezuma County	2		2,558	1,112		1,112	1,229		1,229				39,794
Montrose County:													
La Sal	1		270	2		2	13,718		13,718	47,000			15,371
San Miguel River (Naturita)		18			54	54		17	17				1,902
Ouray County:													
Red Mountain	3		37				246		246	100	13,200	4,000	1,239
Sneffels	3		37,884	10,422		10,422	120,773		120,773	242,500	447,800		504,793
Uncompahgre	11		6,227	368		368	38,167		38,167	13,400	176,000	34,000	54,184
Park County.													
Alma Placers		10			2,699	2,699		568	568				94,869
Beaver Creek		3			3,313	3,313		713	713				116,462
Buckskin	6	6	4,676	1,059	15	1,074	6,584	3	6,587	21,600	81,600	614,000	95,524
Consolidated Montgomery	7	1	3,700	402	5	407	1,724	3	1,727	1,500	800		15,696
Fairplay		46			10,171	10,171		2,022	2,022				357,423
Hall Valley	1		27	1		1	111		111	900	200		231
Mosquito	5		104,386	22,940		22,940	18,924		18,924	55,000	655,400		860,205
Tarryall	2	9	10	13	5,064	5,077		578	578				178,106
Pitkin County: Roaring Fork	5		24,088				238,773		238,773	2,000	807,000	254,000	235,079
Rio Grande County: Summitville	1		27,313	16,979		16,979	14,019		14,019	8,000			605,178

[1] Granite district lies in both Chaffee and Lake Counties.
[2] Includes Cascade and Ute Creek district.
[3] Less than ½ ton.
[4] Includes Box Creek, Granite, Lackawanna Gulch, St. Kevin, Tennessee Pass, Twin Lakes, and Two Bit districts.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Routt County		2			5	5		3	3				$177
Saguache County:													
Kerber Creek	8		1,414	24		24	17,678		17,678	26,000	319,600	62,000	39,346
Myers Creek	1		1				28		28		400		43
San Juan County.													
Animas	17		264,246	17,105		17,105	527,490		527,490	868,000	6,090,300	1,663,000	1,548,075
Eureka	7		967	279		279	5,172		5,172	2,000	48,600	12,000	17,349
Ice Lake Basin	1		19				69		69		6,100	5,000	772
San Miguel County.													
Iron Springs	9	1	178	101	1	102	2,662		2,662	2,000	17,400		6,691
Lower San Miguel		1			7	7		3	3				247
Mount Wilson	2		1	7		7	7		7				250
Upper San Miguel	10		234,651	23,981		23,981	447,843		447,843	76,500	2,816,600		1,327,374
Summit County													
Breckenridge	13	52	1,260	325	894	1,219	11,901	256	12,157	300	35,600	39,000	56,299
Montezuma	7		1,641	14		14	13,808		13,808	5,300	178,900	45,000	24,506
Ten Mile	6		915	46		46	3,773		3,773	200	99,700	141,000	20,575
Wilkinson, Rock Creek, and Green Mountain	4		791	25		25	21,496		21,496	2,200	60,800	458,000	54,237
Teller County: Cripple Creek	99		528,641	133,470		133,470	21,600		21,600				4,686,810
Total Colorado	579	324	2,222,786	349,652	30,377	380,029	7,296,010	5,687	7,301,697	13,496,000	25,148,000	31,444,000	23,877,597

ADAMS COUNTY

Nearly all the output of gold and silver from Adams County in 1941 was recovered as a byproduct from the gravel-washing plants of the Brannan Sand & Gravel Co. and the United Sand & Gravel Co. near Denver.

ARAPAHOE COUNTY

A lessee on the Tresize placer, which extends across the county line into Jefferson County, produced 22 ounces of gold and 4 ounces of silver from the Arapahoe County area in 1941.

ARCHULETA COUNTY

Seven tons of gold-silver ore were shipped to the Leadville smelter from the Last Dollar claim.

BOULDER COUNTY

Central (Jamestown) district.—The Wano mine continued in 1941 to be the principal producer of gold in the Central district; it was operated throughout the year by the owner and several sets of lessees, who shipped the ore to the Golden Cycle mill at Colorado Springs. A lessee at the Smuggler group shipped ore from the mine and dump to the Golden Cycle mill. Associated Metal Mines, Inc., worked the John Jay mine from January 1 to March 31 and shipped 163 tons of ore. Among the other producers of gold were the Black Rose group, Golden Age, and Gray Eagle. About 50 tons of zinc-lead ore were shipped from the Central district to the Midvale (Utah) custom concentrator.

Gold Hill district.—Slide Mines, Inc., operated its Slide-Klondyke-Twin group of mines and 70-ton gravity- and flotation-concentration mill throughout 1941. The gold concentrates caught on burlap tables between the classifier and Wilfley tables were amalgamated, and the rest were shipped to the Leadville smelter. Besides gold and silver, the concentrates shipped to the smelter contained some recoverable copper and lead. The ore from the other producing mines and dumps in the Gold Hill district was shipped to the Golden Cycle mill or the Boulder Ore Sampler. Sizable producers, in order of gold output, were the Ingram group, Sunshine, Emancipation, Melvina, Nil Desperandum, and Little Johnny.

Grand Island district.—The Donora Mining Co. operated the Boulder County mine and 70-ton jig- and flotation-concentration mill under lease throughout 1941, producing gold-silver-lead concentrates which were shipped to the Leadville smelter. Ore was shipped to the Golden Cycle mill and Leadville smelter from the Amy Paul, Blue Bird, Enterprise, Revenge, and other small mines in the Grand Island district.

Magnolia district.—The producing mines in the Magnolia district in 1941 were the Cash-Rebecca, Fortune, Graphic, Hereafter, India, LeRoy, Ben C. Lowell, and Senator Hill.

Sugar Loaf district.—Most of the ore produced from mines and dumps in the Sugar Loaf district in 1941 was shipped to the Golden Cycle mill. The Poorman group continued to be the principal producer of gold; it was followed by the Alpine Horn, Nancy, Wood

Mountain, Grand Republic, and Keystone, each of which yielded more than 100 ounces of gold. The silver output came chiefly from silver ore from the Yellow Pine group and gold ore from the Nancy.

Ward district.—The Ward United Mines Co. operated the Boston-Utica group throughout 1941 and reconditioned the Utica 25-ton concentration mill, which was placed in operation in July. The concentrates and crude smelting ore shipped contained in all 2,535 ounces of gold, 2,872 ounces of silver, and 49,661 pounds of copper. Small tonnages of ore were shipped to the Leadville smelter or the Golden Cycle mill from the B & M mine, Baxter, Captain Jack, Columbia, Golden Queen, Grandview, Hard Rock, Hawkeye, Helen B, and Nelson.

CHAFFEE COUNTY

Chalk Creek district.—Lessees operating the old Mary Murphy mine on a small scale shipped ore containing gold, silver, lead, copper, and a relatively high percentage of zinc to the Midvale (Utah) custom milling plant and selected ore of a similar type but lower in zinc content to the Leadville (Colo.) smelter. A small quantity of lead ore was shipped from another property in the Chalk Creek district.

Four Mile district.—Harry Ault shipped 67 tons of zinc ore containing gold, silver, lead, and copper to the Midvale (Utah) custom concentrator in 1941.

Granite district (see also Lake County).—Only 10 tons of ore yielding 8 ounces of gold and 10 ounces of silver were shipped from lode mines in the Granite district in 1941. Len Savage operated his placer in Lost Canyon intermittently from June to September, using a power shovel and screening-sluicing plant. Wolfe & Hesser operated a ¾-cubic yard power shovel and screening and sluicing plant in Lost Canyon and on Cache Creek from July 12 to August 19. The Cache Creek, Franklin, Independent, Mizer, and other placers on Arkansas River near Granite were worked on a small scale with sluices, and drift mining was done at the Old Channel and Georgia Bar placers.

La Plata district.—A 2-ton lot of gold-silver-lead ore from the Tip Top claim was shipped to the Leadville smelter in 1941.

Monarch district.—A lessee at the Madonna group shipped 12 tons of gold-silver-lead ore in 1941, and another operator in the Monarch district shipped 16 tons of gold-silver-lead-copper ore.

Red Mountain district.—A small lot of gold-silver ore was shipped from the Anchor group to the Golden Cycle mill in 1941.

Turret district.—Small lots of ore were shipped from the Golden Wonder and Monongahela mines to the Golden Cycle mill.

CLEAR CREEK COUNTY

Alice district (Yankee, Lincoln).—A lessee at the Lombard mine shipped 829 tons of gold ore containing some silver, lead, and copper to custom mills in the Idaho Springs district in 1941. The Gold King mine yielded 203 tons of gold-silver ore, part of which was shipped to the Golden Cycle mill at Colorado Springs and part to the Clear Creek-Gilpin mill at Idaho Springs. Other small producers in the Alice district were the Lalla, San Juan, Reynolds, and Whale mines.

Argentine district.—Buckley Bros. operated the Hamill tunnel group in 1941 and produced 601 tons of silver ore, of which 527 tons were concentrated in local custom mills and 74 tons were shipped crude to

the Leadville smelter. The 50-ton flotation mill at the Santiago mine was operated during the summer months; the concentrates produced, containing gold, silver, lead, and copper, were shipped to the Leadville smelter. Some ore from the Paymaster group was shipped to the Ruth custom mill at Idaho Springs.

Empire district.—In 1941 Minnesota Mines, Inc., operated continuously its consolidated group of claims in the area north of Empire; since 1935 this company has been the largest producer of gold in Clear Creek County. The output was 15 percent less in 1941 than in 1940. The ore is treated in the 250-ton mill at the mine by concentration on mats in launders and by flotation followed by cyanidation of the flotation concentrates. After cyanidation the flotation concentrates, containing chiefly iron sulfide, are sold to the General Chemical Co. of Denver for the manufacture of sulfuric acid; the mat concentrates, containing mostly free gold, are amalgamated. Copper Cone, Inc. made a substantial output of gold from the Upper Union-Gold Fissure group; the ore was treated in the Clear Creek-Gilpin and Ruth custom mills at Idaho Springs. The Conqueror Operating Co. shipped 425 tons of gold-silver ore from the Conqueror group to the Clear Creek-Gilpin mill. Other small producers included the Ashland, Cashier, Gold Dirt, Mint, and Pittsburg properties.

Griffith (Georgetown-Silver Plume) district.—The Mile High Mining Co. began work at the Smuggler group in January 1941 and in August began to mine and mill ore. Production to the end of the year was 145 tons of zinc concentrates, shipped to the Amarillo (Tex.) smelter, and 45 tons of lead-silver concentrates, shipped to the Leadville smelter. Ore was shipped to custom mills at Idaho Springs from the Clara B, Hall tunnel, and St. George groups and to the Leadville smelter from the Fargo and Johnny Bull properties.

Idaho Springs district.—The Alma-Lincoln Mining Co., a consistent producer since 1933, operated its Lincoln-South Lincoln-Elliott Barber group and flotation mill throughout 1941 and treated 25,019 tons of ore, compared with 36,404 tons in 1940. The company, which had purchased the Metropolitan property in 1940, took a lease on the Dona Juanita and Cardigan claims in 1941. The Silver Spruce Gold Mining Co. operated its 50-ton mill at Idaho Springs on company ore from the Lord Byron mine from January to the first week in July and on custom ore the rest of the year. A large part of the custom ore came from the Shafter dump. Gold Mines Consolidated, owner and operator of the Dona Juanita-Maude Monroe group of mines and the Gustafson mill, produced and treated 5,613 tons (wet weight) of ore during the year. The Black Eagle mill was operated as a custom plant by S. S. Huntington; most of the ore treated came from the Williams, Diamond Joe, Specie Payment, Freighter's Friend, and Brighton mines. The ore from the last four mines contained, besides gold, considerable silver and lead and some recoverable copper. Other sizable producers of gold-silver-lead-copper ores shipped to custom mills were the Brighton, Hyland, and Idaho Bride. LeRoy Giles & Co. and the Ute Creek Syndicate continued to ship gold-silver ore from the Dixie No. 4 and East Dixie mines, respectively, to the Ruth custom mill. Other producers of more than 100 tons of ore included the Equinox, Golden Edge, Mattie group, Red Jacket, and East Santa Fe. The Banner Mining Co., working the Idaho placer ground, produced

most of the output of placer gold from the Idaho Springs district during the year.

Montana district (Lawson, Dumont).—The output of ore from the Montana district in 1941 comprised 150 tons of lead-silver-gold ore from the Red Elephant group and 25 tons from the Joe Reynolds.

Trail Creek district.—Lamartine Mines, Inc., operated the Lamartine-Falcon group of mines throughout 1941. The ore (29,508 tons) was treated in the company mill by flotation supplemented by jigs in the ball mill-classifier circuit to extract free gold for amalgamation. Bullion sold to the Denver Mint contained 1,788 fine ounces of gold and 461 fine ounces of silver, and concentrates shipped to the Leadville smelter contained 2,668 ounces of gold, 4,738 ounces of silver, 214,817 pounds of lead, and some zinc. Lessees at the Donaldson (Wheatland)-Little Champion group continued to ship ore to custom mills at Idaho Springs and the Golden Cycle mill at Colorado Springs. Other small producers included the Diamond Mountain-Lucky group, Harrisburg, and Lone Tree.

CONEJOS COUNTY

Lessees at the Forest King mine in the Platoro district shipped 45 tons of gold-silver ore to the Golden Cycle mill in 1941.

COSTILLA COUNTY

A car of zinc-lead ore was shipped from Jaroso to the Ozark pigment plant at Coffeyville, Kans., in 1941. Sluicing in Grayback Gulch on the property of the Drum Estate near La Veta recovered a few ounces of placer gold.

CUSTER COUNTY

Output from Custer County in 1941—mostly from the Hardscrabble district—comprised 168 tons of lead-silver ore from the Defender mine, 7 tons of copper ore from the Reito Alta, and 3 tons of lead ore from the High Kicker-Wild Girl group.

DENVER COUNTY

Sluicing on Platte River recovered 6 ounces of placer gold in 1941.

DOLORES COUNTY

Lone Cone district (Dunton).—Modern Gold Mines, Inc., continued to operate the Emma and Smuggler-Almont mines and the Emma 100-ton flotation mill under lease from January 1 to September 1, 1941. The concentrates produced contained gold, silver, and a little lead and were shipped to the Leadville smelter.

Pioneer district (Rico).—The Rico Argentine Mining Co. operated its group of mines and 135-ton selective-flotation mill continuously in 1941 at an average daily rate of approximately 100 tons of ore. The products of the mill were lead-silver concentrates (carrying some copper, zinc, and a little gold) shipped to the Leadville smelter and zinc concentrates (carrying also silver, lead, copper, and a little gold) shipped to the Amarillo (Tex.) smelter. Other output from Rico included zinc-lead-silver and lead-silver ores containing a little copper and gold shipped from the Pro Patria group, the St. Louis Smelting & Refining Co. property, and the Yellow Jacket group to custom mills and smelters in Utah.

DOUGLAS COUNTY

Individuals sluicing on Dry Creek and Newlin Gulch near Parker and Franktown in 1941 recovered small lots of placer gold.

EAGLE COUNTY

Mount Egley district.—A little gold was recovered in 1941 from the Katherine lode claim and a small placer mine on Lake Creek.

Red Cliff district (Battle Mountain).—In 1941 the Red Cliff district ranked first among Colorado districts in output of silver, copper, and zinc and was also an important producer of gold and lead. The Eagle mine, owned and operated by the New Jersey Zinc Co., Empire Zinc Division, was again the chief producer. The company shipped a large tonnage of copper-iron-silver-gold sulfide ore (but much less than in 1940) to the Garfield (Utah) smelter and from June to December operated its 600-ton underground flotation mill on zinc-lead ore, large reserves of which are also developed in the mine. The Ben Butler Corporation shipped 552 tons of gold-silver copper ore from the Ben Butler group to the Garfield (Utah) smelter. Other small producers were the Star of the West and Tip Top mines.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle custom mill at Colorado Springs recovered 42 percent of the total Colorado output of gold from lode mines in 1941. It treated 532,127 tons of ore averaging 0.3038 ounce of gold to the ton compared with 550,521 tons averaging 0.2905 ounce in 1940. Of the total ore treated in 1941, 484,702 tons were gold-[silver]-sulfotelluride ores from the Cripple Creek district (Teller County) and 47,425 tons comprised miscellaneous gold and gold-silver ores from other districts, mainly in Boulder, Clear Creek, and Gilpin Counties. Approximately one-third of the total crude ore is treated by flotation- and table-concentration, and the concentrates obtained are mixed with the other two-thirds of crude ore and roasted. The calcines from the roasters are cooled and ground in Chilean mills to approximately minus-16-mesh and passed over blankets; the blanket concentrates are amalgamated in Wheeler pans and iron arrastres, and the blanket tailings are treated by cyanidation after sand-slimes separation. The concentration-plant tailings (flotation being in cyanide solution) also go to the cyanide plant. The amalgam and precipitates recovered are melted and cast into bars for shipment to the Denver Mint. On October 20, 1941, the mill placed in effect a new treatment schedule which increased the payment for gold $0.86 an ounce.

The cyanide plant of the Mill Tailings Recovery Co. at the old Portland mill dump near Colorado Springs was not operated in 1941.

FREMONT COUNTY

Lessees worked the Green Mountain mine near Hillside intermittently in 1941 and shipped 31 tons of copper-silver ore to the Leadville smelter. Jetter & Andrews shipped 2 tons of dump lead ore from Florence.

GARFIELD COUNTY

Rifle Creek district.—The Gray Eagle Mining Co. operated the Gray Eagle mine 8½ miles from New Castle intermittently in 1941, mostly on development, and shipped some gold-silver-copper ore to the Garfield (Utah) smelter. L. Harmon shipped a car of zinc ore containing a little gold, silver, copper, and lead from the Sunshine mine near Rifle to the custom mill of the International Smelting & Refining Co. at Tooele, Utah. A little ore was shipped from the O. G. and Paupers Dream claims near New Castle.

GILPIN COUNTY

Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).—The Pittsburg-Notaway group of mines and 50-ton flotation mill were operated continuously in 1941 and yielded more than half of the total output of gold from lode mines in the Southern districts of Gilpin County during the year. Operations from January to July were carried on under lease by J. C. B. Millard and during the rest of the year by Kingmill Mines, Inc. The concentrates contained, besides gold, considerable copper and silver and were sold to the Leadville smelter. The California-Hidden Treasure Mines Co. worked the Monmouth-Kansas mine throughout the year, sending the ore produced (1,580 tons) to the Clear Creek-Gilpin mill at Idaho Springs (Clear Creek County) for treatment. The recovery in bullion shipped to the Denver Mint and the content of concentrates sold to the Leadville smelter totaled 775 ounces of gold, 3,909 ounces of silver, 20,927 pounds of copper, and 9,307 pounds of lead. The company also shipped 504 tons of ore from its First National-Kansas group, operated through the Argo tunnel. Work on this group ceased about November 1, 1941. The New Brunswick mine and 15-ton stamp amalgamation-table concentration mill were operated throughout the year. Ore was shipped to the Golden Cycle mill at Colorado Springs and to custom mills in Clear Creek County from the Americus, Federal, Justice, Old Town group, Saratoga, West Notaway, and other mines and dumps in the Southern districts. Chain O'Mines Operators shipped a few cars of gold-silver-lead concentrates to the Leadville smelter.

Manion Placer Mines operated its land dredge on North Clear Creek from April 15 to November 19, 1941. The ground worked comprised the Van Fleet patented land and the Snowstorm, Deal, Independent, and Badger placers. The equipment included a 1½-cubic yard power shovel, ½-cubic yard dragline, caterpillar bulldozer, screening plant on crawlers, and separate sluicing plant on wheels. Other producing placers worked on a small scale with power shovels or draglines and screening and sluicing plants included the McElwee & James, Mission Mines Co., Nevada Gulch, Nugget, and Pleasant Valley. Individuals continued sluicing and panning during the open season on North Clear Creek.

Northern districts. The Perigo group was worked on a small scale by lessees during part of 1941. Most of the ore produced was concentrated in the mill at the mine, yielding gold-silver concentrates that were shipped to the Leadville smelter. One car of crude ore was sold to the Golden Cycle mill. Other shippers of small lots to the Golden Cycle mill were the Independent and Lone Star mines. A

little ore was shipped to the Leadville smelter and to custom mills in Clear Creek County from the Caledonia, McAdams, Providence-Newport, and two other lode properties in the Northern districts. The Gamble Gulch Mining Co. operated its ½-cubic yard dragline and sluicing plant during part of the year in Gamble Gulch. Individuals recovered a little placer gold by sluicing in Lump Gulch.

GRAND COUNTY

Small lots of silver-lead ore were shipped to the Leadville smelter in 1941 from the Bobtail claim in the La Plata district, the Ready Cash near Jones Pass, and the Wolverine about 22 miles north of Granby.

GUNNISON COUNTY

Domingo (White Earth) district.—A 1-ton lot of copper-gold-silver ore was shipped from the Good Smaritan claim in 1941.

Gold Brick district.—The Carter Mines Co. operated its mine and mill on Gold Creek throughout 1941. The ore was treated by amalgamation and by flotation- and gravity-concentration. Ore treated during the year totaled 8,451 tons, from which were recovered bullion containing 1,367 fine ounces of gold and 786 fine ounces of silver and concentrates containing 273 ounces of gold, 5,887 ounces of silver, and 9,008 pounds of lead. Burleson Mines, Inc., operated the Raymond group and mill about 6 months in 1941 and produced 670 tons of ore yielding 79 tons of concentrates containing 137 ounces of gold, 831 ounces of silver, and 20,233 pounds of lead. At the Bertha, Chicago, and Wayne mines small tonnages of ore were produced and treated in amalgamation-concentration mills. A little gold was recovered from the Goldsmith and Phyllis claims.

Green Mountain district.—Small lots of ore were shipped to the Leadville smelter in 1941 from the Chief and Prosperity claims.

Quartz Creek district.—Warner H. Thomas shipped 4 tons of ore containing lead, copper, silver, gold, and zinc to the Midvale (Utah) custom concentrator in 1941. A few tons of silver-lead and gold-silver-lead ore were shipped to the Leadville smelter from the Fairview mine and another property in the Quartz Creek district.

Rock Creek district.—The owners of the Carbonate claim shipped 2 tons of zinc ore containing a little gold, silver, and copper to the Midvale (Utah) custom concentrator in 1941. A 4-ton lot of silver-gold-lead ore was shipped to the Leadville smelter from the Black Eagle claim.

Taylor Park (Tin Cup) district.—In 1941 the Star and Thunderbird mines shipped 96 and 105 tons, respectively, of ore containing zinc, lead, copper, silver, and gold to the Midvale (Utah) custom mill, and the Trail Horse claim shipped 18 tons of gold-silver-lead ore to the Leadville smelter.

Tomichi district.—A sublessee at the Akron mine, under lease to the Callahan Zinc-Lead Co., Inc., shipped 2 cars of zinc-lead silver-gold ore to the Midvale (Utah) custom mill in 1941.

HINSDALE COUNTY

Galena district.—Davis Gold Mines operated the Eldorado 50-ton mill during part of 1941 on company and custom ores and shipped some copper-lead-silver-gold concentrates to the Leadville smelter. The ore milled included 16 tons from the Cherokee dump.

Lake district.—About 2 cars of silver-lead-copper-gold ore were shipped by lessees from the Belle of the West mine, and 1 ton of gold-silver-lead ore was shipped from the Pitkin claim in 1941.

JEFFERSON COUNTY

The old Malachite mine 3½ miles northwest of Morrison, which was reopened in 1940, was operated by lessees for a period during the first part of 1941. The ore produced was concentrated in the Furstenberg mill near Idaho Springs, and the concentrates produced were shipped to the Garfield (Utah) smelter. Later the mine was leased to the American Smelting & Refining Co. Most of the output of placer gold from Jefferson County during the year was recovered by W. B. Kerkling from the Bertrand gravel pit and the Tresize placer

LAKE COUNTY

LEADVILLE DISTRICT

The American Smelting & Refining Co. operated its Arkansas Valley lead bullion-leady copper matte smelter continuously (one furnace) in 1941 on ores and concentrates purchased from operators in virtually all the active mining districts of Colorado. Receipts totaled 121,297 tons compared with 114,371 tons in 1940.

A large part of the mine output of gold, silver, copper, and lead from the Leadville district in 1941 was derived from Ibex dump ore treated in the mills of the California Gulch Mining Co. and the H. G. N. Mining & Milling Co. (name changed to Hamm Mining & Milling, Ltd., September 1, 1941). The first company operated two mills, both equipped for gravity- and flotation-concentration and amalgamation. Mill No. 1, with a daily capacity of 125 tons, was built in 1939 and operated in 1940 and 1941. Mill No. 2 (daily capacity, 450 tons) was completed in May 1941 and operated from June 1 to the end of the year. The Hamm mill (formerly H. G. N.), built in 1937, was operated throughout 1941; it has a daily capacity of 300 tons. The process used is jig-, table-, and flotation-concentration and amalgamation of the cleaner jig concentrate. Ore treated in the three mills totaled 217,693 tons. Andy Caine & Co. treated 2,868 tons of ore from the Fanny Rawlings mine by table concentration and amalgamation in the leased Norton mill. The principal shippers of crude ore to the Leadville smelter (in approximate order of tonnage) were the "Lillian" group, Breece, Iron Hill, Ibex, Dolly B, New Monarch, Ollie Reed, and Little Ellen. Nearly 500 tons of zinc-lead-gold-silver ore from the New Monarch, Rock Hill, St. Louis tunnel, and Yak properties were shipped to the Midvale (Utah) custom concentrator, and 25 tons of zinc-lead ore from the Rock Hill property were sent to the Ozark pigment plant at Coffeyville, Kans.

The Resurrection Mining Co., continuing development work at the Resurrection mine, drove 6,718 feet of drifts and 336 feet of raises, reconditioned 4 miles of the Yak drainage-transportation tunnel and the surface plant at the tunnel portal, and nearly completed the building of a 250-ton flotation mill. The mine workings include a vertical shaft 1,290 feet deep and six levels. The Yak tunnel intersects the shaft at the 850-foot level. The mill was placed in operation

February 1, 1942; the products are lead concentrates (carrying gold, silver, copper, and some zinc) and zinc concentrates (carrying some gold, silver, copper, and lead).

OTHER DISTRICTS

No large producing lode mines operated outside the Leadville district in Lake County in 1941. Those making some output were the Mount Champion in the Lackawanna Gulch district; the Amity, Dinero, and St. Kevin in the St. Kevin-Sugar Loaf district; the Homestake in the Tennessee Pass district; and the Columbine and Gordon-Bengal Tiger in the Twin Lakes district. The Mt. Elbert Mining Corporation operated its dry-land dredge on the Derry Ranch placers in the Box Creek district 12 miles south of Leadville from April 27 to November 25. Small lots of placer gold were recovered at the Cureton and other placers near Granite and Twin Lakes.

LA PLATA COUNTY

California (or La Plata) district (Hesperus, La Plata).—Small tonnages of ore were shipped to the Leadville smelter in 1941 from the Bessie G, Hazel, Gold King, Gold Hope, May Day, and Mountain Lilly mines. A little placer gold was recovered by sluicing on the Eclipse property.

LARIMER COUNTY

Manhattan district.—Small lots of ore were shipped to smelters in 1941 from the Depression claim.

Masonville district.—Lessees at the Little Mary Mason mine shipped tons of gold-silver ore in 1941.

MINERAL COUNTY

Creede district.—Silver production in the Creede district increased 5 percent in 1941 over 1940, following a 45-percent increase in 1940 over 1939. The output of gold recovered from the silver ore also increased slightly in 1941, but that of lead decreased. Most of the ore was treated in the leased 100-ton flotation mill operated by the Emperius Mining Co.; the concentrates produced were shipped to the Leadville smelter. Shippers to the mill comprised the Amethyst group, Commodore, Equinox, and Emco-Chance. Part of the ore from the Commodore and Emco-Chance mines and that from the Ochre mine and the Weaver-Oates lease were shipped direct to the Leadville smelter.

MONTEZUMA COUNTY

The Red Arrow Gold Corporation operated its Red Arrow mine and 25-ton amalgamation mill approximately 9 months in 1941. The mill treated 2,500 tons of ore, and an additional 24 tons were shipped crude to the Leadville smelter. The total content in bullion and crude ore was 1,053 ounces of gold and 1,152 ounces of silver. The Outwest Mining Co. shipped 34 tons of gold-silver ore from the Outwest property, adjoining the Red Arrow.

MONTROSE COUNTY

La Sal district.—Lessees at the Cashin group shipped 270 tons of copper-silver-gold ore to smelters in 1941.

Naturita district.—Individuals sluicing on San Miguel River in 1941 recovered small lots of placer gold.

OURAY COUNTY

Red Mountain district.—The only shipments of ore from mines in the Red Mountain district in 1941 were 27 tons of lead-silver ore from the Mickey lease, 9 tons of zinc-lead ore from the Red Creek group, and 1 ton of lead-silver ore from a prospect.

Sneffels district.—King Lease, Inc., ran its 100- to 125-ton mill throughout 1941 on ore from the Camp Bird mine. The ore was transported from the mine workings to the mill through the 11,000-foot low adit. In treatment the ore was fed from the mill bins to jaw crushers and then to ball mills; the pulp from the ball mills was amalgamated on plates, and the pulp from the plates was sent to the flotation circuit where bulk gold-silver-copper-lead-[zinc] concentrates were made for shipment to smelters. The gold-silver bullion recovered was sold to the Denver Mint. The only other output of ore from the Sneffels district during the year was 10 tons of lead-silver ore from the Mountain Top claim and less than 1 ton of gold ore from another property.

Uncompahgre district.—G. A. Franz, Inc., operated its 120-ton flotation mill 2 miles north of Ouray in 1941 on custom ores from the Syracuse-Bachelor and Pony Express groups. The mill treated 4,862 tons of ore yielding 167 tons of lead-silver concentrates (containing some copper and gold) and 55 tons of zinc concentrates (containing also silver, lead, and a little gold and copper). The lead-silver concentrates were shipped to the Leadville smelter and the zinc concentrates to the Amarillo (Tex.) smelter. The McCullough Lease shipped gold-silver-copper ore from the American Nettie and Wanakah groups direct to smelters and treated 780 tons of old tailings from the Wanakah mill dump in the 50-ton flotation mill on the property. Small tonnages of smelting ore were shipped from other mines in the Uncompahgre district, including the Chief Ouray group, Newsboy, Portland, and Senorita.

PARK COUNTY

Alma Placers district.—The only substantial producer on the Alma Placers in 1941 was Jack Richards, who shipped gold to the Denver Mint steadily from May to October. The gravel was dug from open pits by power shovels and hauled by trucks to the central sluicing plant for treatment.

Beaver Creek district.—The Timberline Dredging Co. operated its electric floating connected-bucket dredge on Beaver Creek near Fairplay from April 27 to November 2, 1941, and handled 632,400 cubic yards of gravel; the dredge is equipped with 84 buckets, each with a capacity of 7½ cubic feet. Other producers from placers on Beaver Creek were the Detwiler Lease and E. E. Lytle.

Buckskin district.—The Phillips group was operated by 2–3–4 Mines, Inc., from January 1 to March 31, 1941, and by Buckskin

Joe Mines, Ltd., from April to the end of the year. The ore produced (4,539 tons) was treated by selective flotation in the leased Alma Betts 50-ton mill 6 miles from the mine. The products of the mill were zinc concentrates (carrying some gold, silver, copper, and lead) shipped to the Amarillo (Tex.) smelter and iron concentrates (containing gold, silver, lead, and zinc) and lead concentrates (carrying gold, silver, copper, and zinc) shipped to the Leadville smelter. A lessee at the Gold Ridge mine shipped 67 tons of zinc ore (containing gold, silver, copper, and lead) to the Midvale (Utah) custom mill and 41 tons of gold-silver-lead-copper ore to the Leadville smelter. Other small lode producers included the Buckskin and Kentucky Belle mines. Sluicing in Buckskin Gulch recovered a little placer gold.

Consolidated Montgomery district.—The Magnolia Gold Mining Co. continued in 1941 to work the Magnolia mine and produced 3,600 tons of gold-silver ore containing a little copper. The ore was transported by a 4,000-foot aerial tramway to the company mill in Montgomery Gulch and treated by table- and flotation-concentration. Small tonnages of ore were shipped to the Golden Cycle mill and the Leadville smelter from the Alice Lee, Creighton, Kansas, Ketsby, Lee Goss, and Prince Albert mines. About 5 ounces of placer gold were recovered in Montgomery Gulch.

Fairplay district.—The new 10,000-cubic yard (per day) steel connected-bucket dredge of the South Platte Dredging Co. began operating June 11, 1941, on bench ground along the Platte River near Fairplay and ran continuously the rest of the year. The dredge is powered by electricity and is equipped with 108 buckets, each with a capacity of 12 cubic feet. The Snowstorm placer north of Fairplay yielded a substantial output during the year. About 38 companies and individuals, several of whom used power shovels and land washing plants, worked on the property. Among the larger producers were the B. & H. Exploration Co., Philton Mines, and Miles O. Deatherage. Sluicing was done at other placers on Platte River near Fairplay.

Hall Valley district.—A lessee at the La Clede claim shipped 27 tons of gold-silver-copper-lead ore to the Ruth custom mill at Idaho Springs (Clear Creek County).

Mosquito district.—The London Mines & Milling Co. continued in 1941 to be the principal producer of gold, silver, copper, and lead in the Mosquito district and in Park County. The company owns and operates a consolidated group of mines on London Mountain opened by a 4,400-foot tunnel. The ore is treated in the company 200-ton flotation- and gravity-concentration mill near the portal of the tunnel. The concentrates produced contain chiefly gold, with some silver, a little copper, and considerable lead and zinc; they are sold to the Leadville smelter. The London-Butte Gold Mines Co. operated its Butte mine and 100-ton flotation mill throughout the year. The 150-ton Record mill was purchased by James N. Redman, trustee, from the London Extension Mining Co. on May 10, 1941; it was operated after July 23 and treated a total of 14,613 tons of ore, of which 2,143 tons came from the American mine, 11,679 tons from the London Extension reject dump, 476 tons from the South London dump, and 315 tons from the Record mill dump. Small lots of ore were shipped to the Leadville smelter from the Orphan Boy and Susquehanna mines.

Tarryall district.—The large increase in gold output from the Tarryall district in 1941 came from the Peabody-Volz group of placer mines

on Tarryall Creek 2 miles north of Como. The ground was leased in 1940 by Cooley Bros., *who installed a 3,000-cubic yard (per day) drag-*line floating dredge on the property during the first part of 1941 and operated it from May 4 to December 4. The Sterling Mining Co. operated its 1½-cubic yard dragline and four-bowl land dredge on the Little Mint-Storming Jordan placer on Tarryall Creek about 7 miles below Como during September and October. Gale L. Odell worked the Roberts placer on Tarryall Creek 2½ miles northwest of Como from June 15 to November 10 with a 1½-cubic yard dragline and screening and sluicing plant on wheels. Other placers on Tarryall Creek were worked by hand methods. A small output of gold and silver was made from the Stormchild and King Solomon-Pikes Peak lode properties.

PITKIN COUNTY

Roaring Fork district (Aspen).—The Midnight Mining Co. operated its Midnight mine and flotation mill continuously 6 days a week in 1941. The mill had a daily capacity of 60 tons, but the company had machinery on hand at the end of the year to raise the capacity to 75 tons or more. Ore treated in 1941 totaled 7,500 tons. The mill produced lead-silver concentrates, which were sold to the Leadville smelter, and zinc concentrates, which were shipped to the Amarillo (Tex.) zinc smelter. D. P. Rohlfing continued to ship to the Leadville smelter lime fluxing material carrying silver and lead from the Smuggler, Spar Consolidated, and other groups under his management. A lessee of the Hunter Creek flotation mill shipped a small tonnage of lead-silver concentrates recovered in the milling of silver- and lead-bearing dump material. A few tons of smelting ore were shipped from the Enigma and Unexpected claims.

RIO GRANDE COUNTY

Summitville district.—Gold production in the Summitville district, only producing district in Rio Grande County in 1941, increased 34 percent over 1940. All the output in both years came from the group of mines operated by Summitville Consolidated Mines, Inc. In 1941 the company treated a daily average of 83 wet tons of ore, 7 days a week, in its 150-ton mill at Summitville. In treatment the ore is ground in a ball mill with cyanide solution to minus-100-mesh. A jig between the ball mill and classifier removes coarse high-grade gold-silver-pyrite concentrates, which are shipped to the Leadville smelter. The classifier overflow goes to primary thickeners to remove pregnant solution; the primary thickener underflow goes to agitators and from them to three stages of countercurrent decantation. The pregnant solution is precipitated in Merrill-Crowe units, and the precipitates are acid-treated and reduced to bullion for shipment to the Denver Mint. During the year the company also carried on developing and prospecting work within the mine area on a deposit containing copper which previously had been avoided.

ROUTT COUNTY

Individuals recovered some gold and silver in 1941 from placers in the Hahns Peak area.

SAGUACHE COUNTY

Kerber Creek district (Bonanza).—Lessees at the Rawley group continued in 1941 to ship lead-silver-copper ore to smelters. The Flagstaff Mining & Milling Co. made intermittent test runs in its 50-ton flotation mill on ores from several properties. The ore treated included 205 tons of zinc-lead ore, which yielded 51 tons of zinc concentrates sold to the Ozark Smelting & Mining Co. plant at Coffeyville, Kans., and 10 tons of lead concentrates shipped to the Leadville smelter. Lessees on the Rawley No. 3 mine shipped some zinc-lead-silver-copper ore to the custom concentrator at Midvale, Utah. Other shippers of direct-smelting ore included the Liberty mine, Minnie Lynch, and Rico.

Myers Creek district.—The owners of the Silver Dollar claim shipped 1 ton of lead-silver ore to the Leadville smelter in 1941.

SAN JUAN COUNTY

Animas district.—Throughout 1941 the Shenandoah-Dives Mining Co. operated its consolidated group of claims on King Solomon Mountain (opened by the Mayflower tunnel) and 750-ton selective-flotation mill on Animas River near Silverton. The mill treated 231,519 tons of ore from company mines and 3,995 tons from other mines in San Juan and Ouray Counties. Output from the mill totaled 7,044 tons of combined lead-copper, zinc, and iron (lead) concentrates, containing in all 15,398 ounces of gold, 336,034 ounces of silver, 951,813 pounds of copper (wet assay), 3,443,741 pounds of lead (wet assay), and 2,161,931 pounds of zinc; the lead-copper and iron (lead) concentrates were shipped to the Leadville smelter, and the zinc concentrates (1,376 tons of 56.7 percent zinc content, with also gold, silver, and minor lead and copper content) to the Amarillo (Tex.) smelter. The bulk of the custom ore came from the Silver Lake mine of the American Smelting & Refining Co., worked through a 3,000-foot crosscut from inside the Mayflower tunnel. The rest came largely from the Coming Wonder and Little Fannie mines in the Animas district; the Esmeralda, Lead Carbonate, and Mountain Queen in the Eureka district, San Jaun County; and the Bachelor in the Uncompahgre district, Ouray County. Highland Mary Mines, Inc., operated the Highland Mary mine and 70-ton flotation mill from June 1 to December 5, 1941. The concentrates produced (containing gold, silver, copper, and lead) were shipped to the Leadville smelter. The Pride of the West Mining Co. operated its 70-ton selective-flotation mill continuously on company lead-zinc-gold-silver-copper ore from the Pride of the West group. Nearly 90 percent of the mill product was lead concentrates (containing gold, silver, copper, and some zinc) shipped to the Leadville smelter; the rest was zinc concentrates shipped to the Amarillo (Tex.) smelter. On January 9, 1942, a fire which destroyed the buildings at the portal of the mine closed it until May 17. Some ore was shipped direct to the Leadville smelter in 1941 from the Crusader, Golden Eagle, and other mines in the Animas district.

Eureka district.—Most of the ore produced from mines in the Eureka district in 1941 was sold to the Shenandoah-Dives mill (see Animas district). About 1 car of high-grade gold-silver ore was shipped to

the Leadville smelter from the Brooklyn mine. The Treasure Mountain Gold Mining Co. erected a 25-ton flotation mill at the portal of the Sandiago tunnel and treated 377 tons of gold-silver ore from the Golden Fleece dump. The Sunnyside mine and 1,000-ton selective-flotation mill at Eureka, closed June 30, 1938, remained idle throughout 1941.

Ice Lake Basin district.—The only output from the Ice Lake Basin district in 1941 was 19 tons of zinc-lead ore shipped to the Midvale (Utah) custom mill.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—Nearly all the metal output from the Iron Springs district in 1941 was contained in small tonnages of ore shipped to the Leadville smelter from the Carbonero, Hattie, New Dominion, San Bernardo, Sulphurette, Texas, and Yellow Jacket properties. The Butterfly mill at Ophir was destroyed by fire December 6, 1940; the Butterfly-Terrible-Silver Bell group had no output in 1941.

Lower San Miguel district (Sawpit, Vanadium).—Sluicing on San Miguel River 5 miles from Norwood recovered 7 ounces of gold and 3 ounces of silver in 1941.

Mount Wilson district.—A little high-grade gold ore was shipped from the Silver Pick mine in 1941, and about 3 ounces of gold were produced from another property in the Mount Wilson district.

Upper San Miguel district (Telluride).—Veta Mines, Inc., operated its amalgamation and gravity- and flotation-concentration mill at Pandora 2½ miles east of Telluride at an average rate of 532 tons daily for 365 days in 1941 compared with 486 tons in 1940. The company ore treated in 1941 (193,768 tons) came from the Smuggler Union, Cimarron, and Montana mines and the Smuggler, Cimarron, and Tomboy dumps; the custom ore (315 tons) came from the Pike County mine and the Tomboy dumps. About one-third of the gold output from the mill was recovered in gold-silver bullion and the rest in concentrates, which also contained the bulk of the recoverable silver and all the recoverable lead. The bullion was shipped to the Denver Mint and the concentrates to the Leadville smelter. Alta Mines, Inc., operated the Alta-St. Louis group and 150-ton gravity- and flotation-concentration mill throughout 1941 and produced 40,498 tons of ore yielding 3,185 tons of concentrates containing 2,546 ounces of gold, 115,330 ounces of silver, 95,774 pounds of copper, 1,032,178 pounds of lead, and 463,245 pounds of zinc; the concentrates were shipped to the Leadville smelter. Individuals working small mines and prospects in the Upper San Miguel district recovered some gold from high-grade ore reduced by hand methods.

SUMMIT COUNTY

Breckenridge district.—Small-scale operations only were carried on at lode mines in the Breckenridge district in 1941, and most of the ore produced was shipped direct to the Leadville smelter. A car of zinc ore from the Royal Tiger property was shipped to the Ozark Smelting & Mining Co. smelter at Coffeyville, Kans., and some zinc-bearing material from the Sally Barber dump was shipped to a custom mill at Idaho Springs (Clear Creek County). Producers of more than 25

tons of ore shipped to the Leadville smelter were the Bemrose lode, Carbonate, Dunkin, Fredonia, and Minnie B.

The leading producing placer mines in the Breckenridge district, some of which were equipped with small land dredges, were the Bemrose-Bostwick, Blue Beach, Ford and Bedrock, Long Island (worked by hydraulicking), Louis D, and Van Winkle.

Montezuma district.—G. W. Goodman continued in 1941 to work the Bullion group under lease from the Golden Cycle Corporation. Most of the time was spent in driving development drifts and putting in chutes in preparation for stoping. The mine is equipped with a 75-ton gravity- and flotation-concentration mill. About 180 tons of ore were treated during the year, yielding 44 tons of lead-copper-silver concentrates shipped to the Leadville smelter. The Plymouth Milling Co. worked throughout the year at the New York, Waterloo, and Silver King mines, reopening old tunnels and installing tracks, air pipes, and other equipment needed for mining. The company also built a 125-ton electric-powered selective-flotation mill. The mill was run intermittently for testing ores from August to December and treated 1,127 tons yielding 108 tons of lead-silver-copper-gold concentrates, shipped to the Leadville smelter, and 49 tons of zinc concentrates, sold to smelters at Coffeyville, Kans., and Amarillo, Tex. A small tonnage of lead-silver ore was treated in the 24-ton mill at the Marlin group. The 150-ton mill on the Pennsylvania property was remodeled to treat zinc and lead ores by flotation; the mine was not operated during the year. The Erickson, Florado, and Foremost mines shipped lead-silver ore to the Leadville smelter.

Ten Mile (Kokomo, Robinson) district.—Lessees at the Washington and Hancock mines (known as the Lucky Strike group) shipped 766 tons of zinc-lead-silver ore to the Midvale (Utah) custom concentrator in 1941. The Wilfley Leasing Co. installed flotation equipment in the Wilfley mill and made test runs on ore from the Wilfley mine; 12 tons of concentrates containing 4.70 ounces of gold, 201 ounces of silver, 4,760 pounds of lead, and 1,214 pounds of zinc were produced. Shippers of direct-smelting ore included the Leopard, Polar Star, Sammy B, and Silver Queen mines.

Wilkinson, Rock Creek, and Green Mountain district.—Walter McDaniel continued producing rich zinc-silver-lead-gold-copper ore from his Big Four mine on Green Mountain; the ore was shipped to the Midvale (Utah) custom mill. The mine is opened by a 760-foot tunnel with a 325-foot drift from a point 400 feet within the tunnel. Output in 1941 was 752 tons of ore containing 627,501 pounds of zinc, 23,637 ounces of silver, 58,941 pounds of lead, 20.5 ounces of gold, and 3,509 pounds of copper. Small tonnages of lead-silver-gold ore were shipped to the Leadville smelter from the Boss-Thunderbolt, Chief Mountain, and another property in the Wilkinson district.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

Cripple Creek is the leading gold-producing district in Colorado. From 1891, when gold was discovered in that area, through 1941 it has yielded a total of 18,316,289 fine ounces valued at $394,644,597, or 48 percent of the State total output of gold from 1858 to 1941, inclusive.

In 1941 the district produced 133,470 ounces (35 percent of the State total) compared with 128,932 ounces (35 percent) in 1940 and 134,003 ounces (37 percent) in 1939. The increase in output in 1941 resulted from completion of the 6-mile Carlton drainage tunnel, permitting resumption of mining on the lower levels of the Ajax and Cresson mines. Details of work done during the year on the Carlton tunnel are given in the following Mines Review. The total output of ore from Cripple Creek mines and dumps in 1941 was 528,641 tons, of which 484,702 tons were shipped to the Golden Cycle mill (operations reviewed under El Paso County). Ore milled locally included 34,053 tons treated by flotation in the Cameron mill and 8,885 tons treated by cyanide leaching in the Kavanaugh plant. Cripple Creek ores generally contain gold as the only commercial metal, but some silver ore has been shipped from two or three veins in the district; a small quantity of silver is recovered annually in bullion and concentrates produced from the gold ores.

MINES REVIEW

Operations of the Golden Cycle Corporation, which owns and operates the Golden Cycle mill at Colorado Springs and several mines in the Cripple Creek district, are described in the following extract from its annual report to stockholders for the year ended December 31, 1941 (dated March 1, 1942):

In spite of adverse economic conditions existing in the gold-mining industry, the Cripple Creek district shipped to the Golden Cycle mill 484,702 tons with a [settlement] gross value of $4,640,419.99 and an average value of $9.57 per ton. This compares with 485,155 tons with a [settlement] gross value of $4,394,533.57 and an average value of $9.06 per ton for 1940 This increase in value was partly due to ore coming from the lower levels of the Ajax shaft of the Golden Cycle Corporation, which was completely drained by the Carlton tunnel in February 1941. All the lower levels of the Ajax were under water during the year 1940.

As in previous years, the United Gold Mines Co. and the Cresson Consolidated Gold Mining & Milling Co. were the largest shippers to the mill, with the Golden Cycle Corporation mining operations third. These three companies accounted for 66 percent of the ore. Lessees working on all properties in the district accounted for 83 percent of all the ore shipped from the Cripple Creek district, and all properties are dependent upon the lessees for the greater part of their tonnage.

Carlton tunnel.—The Carlton tunnel was finished to the breccia granite contact under the Portland in September 1941. 6,293 feet of tunnel was driven in 1941. From July 18, 1939, to September 1, 1941, a total of 32,927 feet or 6.236 miles of tunnel was driven. The daily average was 46.9 feet. The last 4,000 feet of tunnel were driven under extremely difficult conditions, due to the heavy flows of water encountered. The first water cut in the tunnel was on February 18, 1941, when the New Market fault in Ajax was reached. The flow of water at this time amounted to 25,000 gallons per minute. Work in the tunnel was suspended for about 10 days until the water subsided to about 10,000 gallons per minute. It was then necessary to drop back about 200 feet from the face and change the course of the tunnel, in order to cut the fault in a different place It was necessary to timber about 150 feet of heavy ground through the fault. From this point on, the tunnel was driven to the Portland without any great difficulty except heavy flows of water.

It was expected, when the breccia granite contact was reached, that enough water would be cut to quickly drain the Portland mine workings. 800 feet of water stood in the Portland shaft at this time. Due to the tight ground only a small flow of water was opened, which did not give rapid enough drainage. It was then necessary to drive a 125-foot raise from the tunnel, and from the top of the raise run a short crosscut toward the winze level of the Portland No. 2 shaft and drain the Portland workings in this manner. When this water was released the tunnel

flow increased to about 125,000 gallons per minute for a few hours, gradually subsiding to 6,000 gallons per minute. The heavy flow of water caused considerable damage in the tunnel, washing out track in several places and leaving considerable debris which was carried in from the Portland workings. This, however, has all been cleaned up and the tunnel is now in good shape.

Ajax operations.—Lessees and the dump, which the company was washing and sorting, furnished all the production for the Ajax until the Carlton tunnel drained the mine in February 1941. When the tunnel cut the New Market fault, the mine drained in 10 days time. Clean-up and repair work was started at once and within 2 months ore from the lower levels was being shipped to the mill. Production the latter part of the year was much greater than the first part, and the mine showed a profit instead of a loss. Company and lessees shipped 29,332 tons with a gross value of $437,760.05 and an average value of $14.92 per ton. This is above the average grade of ore shipped from the district and compares with 22,203 tons with a gross value of $226,628.07 and an average value of $10.21 per ton for the year 1940.

Development work opened ore on both the New Market and Bobtail vein systems on the 24th and 26th levels, and several drifts are now being driven on ore in different parts of the mine. Shaft sinking which is now in progress will open two new levels, the 27th and 28th. Crosscutting and drifting for the various vein systems will start on these new levels as fast as conditions permit.

Index operation.—During the first 10 months of 1941, the Index was operated by the company mainly for the accommodation of split-check lessees. The company, however, accomplished considerable development work and opened a number of small ore chutes, none of which were large enough to mine and make any money. It was decided to close the mine down on November 1, 1941, after the number of lessees dwindled to one set. A total of 1,662.5 feet of development work was done on the property during the year.

Anchoria Leland operation.—Development work on this property totaled 1,848 feet, of which the company accomplished 720 feet and the lessees 1,128 feet. Production amounted to 9,228 tons with a gross value of $92,956.30 and an average value of $10.07 per ton. Operations showed a loss for the year after depletion of $4,224.71.

Development work is still continued on this property mainly by lessees, and it is hoped that sufficient ore will be opened to operate the mine at a profit.

The annual report of the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district, for the year ended December 31, 1941 (dated February 15, 1942), gives the following details on operations at individual mines:

Production by company and lessees was 149,235.80 tons, with a gross value of $1,430,199.42 and an average value of $9.58. Lessees produced 92.7 percent of the tonnage and 95.5 percent of the gross value of the ore shipped. The Portland No. 1 and No. 2, Rose Nicol, Vindicator, Hull City, and Theresa shafts were operated on company account mainly for the accommodation of split-check lessees. Due to the present national emergency, a severe shortage of labor and lessees exists in the Cripple Creek district. The number of lessees working on the various United Gold Mines Co. properties has dropped off very greatly during the latter part of the year. We now have 42 sets of split-check lessees, 13 sets of royalty lessees, and 21 sets of dump lessees.

Portland group.—Both the Portland No. 1 and No. 2 shafts were operated on company account during the year, No. 1 shaft entirely for the accommodation of split-check lessees. These lessees produced a substantial tonnage of a good grade of ore. Portland No. 2 shaft has now become the main operation, due to its drainage by the Carlton tunnel. Shaft repairs and clean-up work was carried out on the 23rd, 24th, 26th, 27th, 29th, and 30th levels. Pipe lines and track are being installed in order to make as much of the mine accessible for work as possible. It is planned to do some development work on these levels, provided we can secure the necessary labor and material.

The company has been carrying on a development program throughout the year on the 17th level in Rose Nicol territory. In the course of this work the Trail basalt blow-out, which was mined on the Rose Nicol, was cut and found to be a fair grade of ore. Stoping will be started on this as soon as an air connection can be made with the 14th level of the Cresson mine.

Rose Nicol.—The company mined and shipped 7,467.20 tons of ore, with a value of $6.38 per ton, and the lessees shipped 9,443.74 tons with an average value of $13.67, or a total of 16,910.94 tons with a gross value of $176,725.99.

No production was made from Rose Nicol ground through the Cresson shaft during the past year, as the Cresson Co. was not able to handle the extra tonnage.

Vindicator group.—The Vindicator made a very good production during the past year. It produced 34,628.20 tons, with a gross value of $380.062.51. An average of 18 sets of lessees was active, employing about 55 men. The Theresa and Hull City shafts were steady producers throughout the year. Some company development work was done on the Theresa shaft. A new ore house was constructed at the Hull City at a cost of $1,800.00.

Shurtloff & Findley.—This property is under lease to the Golden Conqueror Mines, Inc., and is being worked through the South Burns shaft of the Acacia Gold Mines Co. A steady production was maintained during 1941, and a large amount of development work was also accomplished.

Wild Horse group.—The Wild Horse shaft was in operation during part of 1941. Some low-grade ore was shipped, but it was of such muddy, sticky character that the mill could not handle it and the mine was forced to close. The Gleason shaft of the Wild Horse was under lease to Dwyer Brothers and produced a smal tonnage of ore.

Patti Rosa.—This is under lease to the Tennessee Mines Co., who were steady shippers during the year. The Patti Rosa shaft was repaired and a skip installed to take the place of the bucket formerly used. This should speed up their production for 1942.

Deadwood.—This property is under lease to the Gold Bullion Mines, Inc., who maintained a steady production throughout the year.

Due to a safety program we have carried on for the past 3 years, our rate on compensation insurance has been cut from a high of $8.81 3 years ago to $6.198 for the year 1942.

Production of company ore by United Gold Mines Co. in 1941

Mine	Net tons	Gross value [1]	Company ore cash receipts	Average gross value ton [1]
Vindicator	1,513	$6,830 79	$2,293 83	$4.52
Rose Nicol	7,467	47,647 52	23,223 08	6.38
Portland	375	4,134 10	2,451 86	11.02
Theresa	102	404 89	112 68	3 99
No. 2 Plant	1,478	5,978 67	1,731 36	4.04
	10,935	64,995 97	29,812 81	5.94

[1] Settlement value.

Production of lessee ore of United Gold Mines Co. in 1941

Group	Net tons	Gross value [1]	Royalties received	Lessees' receipts	Average gross value per ton [1]
Vindicator	33,115	$373,231.72	$94,735 67	$133,233 73	$11.27
Rose Nicol	9,444	129,078 47	36,734.98	49,925 66	13 67
Portland-Last Dollar	35,038	359,863 68	84,772 39	133,286 46	10 27
Theresa	9,392	102,136 82	31,471 11	29,336 64	10 88
Hull City	6,203	62,633 11	20,222 03	18,844 51	10 10
Deadwood group	28,840	220,836 22	17,196 18	91,356 91	7 66
Hardwood group	10,679	70,349 09	3,454 73	25,644 57	6 59
Londonderry group	3,205	23,279.27	1,397 18	8,360 50	7 26
W. P. H. group	2,384	23,795 07	1,972 71	10,236 61	9 98
	138,300	1,365,203.45	291,956.98	500,225 59	9 87

[1] Settlement value.

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to December 31, 1941

	Net tons	Gross value [1]
Ore mined before consolidation	26,310	$456,806 19
Production under operation of United Gold Mines Co	2,220,065	23,375,026.05
Total to Dec. 31, 1941	2,246,375	23,831,832 24

[1] Settlement value.

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1941 (dated January 15, 1942) says—

The following is a summary of the development work for the 12 months ending December 31, 1941:

Development

	Feet	Feet
Drifts and crosscuts:		
Company	2,495	
Hart group	708	
Lessees	1,506	
		4,709
Raises and winzes:		
Company	435	
Lessees	1,644	
		2,079
		6,788

Production during the year was maintained at full capacity of the plant. Development work was also continued on all blocks of undeveloped ground where it was felt an ore chute might be opened. Some bodies of ore were opened by the company on the 5th, 12th, 13th, and 16th levels. One large stope of low-grade ore is being mined by the company on the 16th level at the present time.

There are 30 sets of split-check lessees working through the Cresson shaft. These lessees made a very good production during the past year. One set of lessees, working on the 10th level, opened up and shipped some very high-grade ore.

The Gold Sovereign shaft is under lease to F. G. Blackwood & Co., and produced a considerable tonnage of low-grade ore.

The Carlton tunnel, driven by the Golden Cycle Corporation, was completed to the Portland No. 2 shaft, and a raise completed through to the 31st level. Preparations are now under way to connect the Portland No. 2 shaft with the tunnel level.

The first large flow of water was cut in the tunnel about the middle of February 1941, and drainage of the southern part of the district began almost immediately. The tunnel is now making 6,000 gallons per minute, although at one time a flow in excess of 100,000 gallons per minute was encountered. The water level in the Cresson shaft has been lowered 240 feet since the middle of February. The 19th level, which is 250 feet below the Roosevelt tunnel, is now dry, and clean-up work on this level is under way. There are several drives to be made on this level, and it is felt that some ore will be opened.

While the rate of drainage at the Cresson shaft was at first rapid, the rate of drainage at the present time is slowing down. It will be over a year before the 20th level, which is 125 feet below the 19th level, is unwatered. For this reason, it will be necessary for the Cresson Co. to drive a 4,000-foot lateral from the main Carlton tunnel into Cresson ground, in order to obtain drainage at a rate fast enough to keep the necessary development work ahead of mining. The Cresson might eventually drain almost to the same level as the Carlton tunnel, but it would require a great many years. It would not allow us to open up the ground below the level we are now working, nor drain at a fast enough rate to keep the mine going.

The lateral from the main Carlton tunnel to the Cresson will be about 4,000 feet in length. Approximately two-thirds of the distance will be through ground owned by the United Gold Mines Co. The remaining distance will be through Cresson ground. Arrangements for a lease on the ground belonging to the United Gold Mines Co., through which the tunnel will pass, have been made; so the Cresson Co. will be protected on any ore this lateral might open. This work will be started as soon as the Portland shaft is completed to the Roosevelt tunnel level. Arrangements have been made to use the tunnel equipment owned by the Golden Cycle Corporation for this work.

Economic conditions caused by the war are beginning to be felt very severely. A shortage of labor and lessees exists throughout the Cripple Creek district and is getting worse as time goes on. Men are naturally attracted by the much higher wages paid by defense industries. A raise in wages, amounting to about 8½ percent, was made by the mines 3 months ago; but with this raise wages here are below all Government work. The price of most mining supplies has raised during the past year.

Compensation insurance costs decreased again this year to a new low of $4.057 per $100 of pay roll. This is the lowest rate in the Cripple Creek district.

The average operating cost per ton shipped by company and the lessees during 1941 was $2.880 on a total of 130,166 tons.

Federal taxes	$0.171
State income taxes	.017
State and county taxes	.084
Sales, service, and use tax	.018
Capital-stock taxes	.021
Social-security taxes	.015
Miscellaneous taxes	.001
Unemployment-compensation insurance	.047
Compensation insurance	.021
Fire insurance	.008
Business insurance	.007
Salaries of officers and directors	.037
General expense	.040
Mining operations	2.388
Group insurance	.005

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to December 31 1941

Period	Dry short tons	Gross value [1]	Freight and treatment	Net value
1903 to Dec 31, 1940	2,963,009	$43,841,173 73	$14,315,107 78	$29,526,065 95
1941:				
Company ore	53,223	363,821 13	181,641 91	182,179 22
Lessee ore	76,943	973,658 53	333,745 19	639,913 34
1903 to Dec 31, 1941	3,093,175	45,178,653 39	14,830,494 88	30,348,158 51

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1940			$14.80	$9 96	$13,381.672 50
1941:					
Company ore			6 84	3 42	97,600.00
Lessee ore	$317,291 56	$322,621.78	12 65	8.32	
1903 to Dec. 31, 1941			14.61	9 81	[2] 13,479,272.50

[1] Settlement value.
[2] Represents 29.84 percent of gross value and 44.42 percent of net value.

Shipments from the Stratton properties in 1941 totaled 28,738 tons of mine ore and 15,113 tons of dump, which together had a total gross settlement value of $416,305.78 or an average settlement value of $9.49 per ton. Most of the ore was mined by lessees under the royalty system. The bulk of the dump ore was shipped by the Regain Corporation from three groups of dumps on Bull Hill. The principal producers of mine ore were the Alie Bell Mining Co. (Proper mine), C. E. Sullivan and Longfellow Mining Co., A. S. Cobb, and J. E. Van Dewalker.

Cameron Gold Mines, Inc., operated its group of mines and 100-ton flotation mill continuously in 1941. Ore treated totaled 34,053 tons yielding 1,503 tons of concentrates containing 5,038 ounces of gold and 2,910 ounces of silver; the concentrates were shipped to the Leadville smelter. The mill feed included 1,072 tons of custom ore milled for the Tenderfoot Mining Co. Thomas Kavanaugh operated his Iron Clad group and cyanide plant 6 months during the year, treating 8,885 tons of ore yielding 504 fine ounces of gold and 77 fine ounces of silver. In approximate order of gold output, the Empire Lee, Free Coinage, El Paso, Acacia, Dr. Jack Pot, Jerry Johnson, Mary Nevin, and Mary McKinney continued to be important producers in 1941. Some of the other producing mines and dumps were the Atlas, Black Belle, Buckeye, Cardinal-Great West, Delmonico, Economic dump, Joe Dandy, Nellie V and War Eagle, New Gold Dollar, and Strong.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES

(MINE REPORT)

By A. J. Martin

SUMMARY OUTLINE

The mine output of recoverable gold, silver, copper, lead, and zinc in the Eastern States in 1941 was valued at $34,159,265—$5,941,270 more than in 1940 and the highest value in any year since 1917. Zinc represented 86 percent of the total in both 1941 and 1940 and 85 percent in 1917. Mine shipments of zinc in 1941 increased 7 percent over 1940 and set a new annual record. Gains in production and shipments were made in New Jersey, New York, and Tennessee; in Virginia actual production of both zinc and lead during the year was less than in 1940,but the quantities shipped (production credited to year of shipment in the tables that follow) were larger. Lead production increased in New York and decreased in Tennessee. The output of copper, nearly all of which came from North Carolina, Pennsylvania, and Tennessee, increased 6 percent over 1940. Gold production rose 19 percent and was the highest in both quantity and value since 1882. The principal gold-producing States were South Carolina, North Carolina, and Pennsylvania. The silver output was recovered from the refining of the gold, copper, and lead produced.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0 7735	$0 121	$0 059	$0 065
1938	35 00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35 00	[6] .711+	.113	.050	.063
1941	35 00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31,1934, was $20.67+($20 671835) per fine ounce.
[2] 1937. Yearly average weighted Treasury buying price for newly mined silver, 1938–41· Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

Annual figures for the 5 years ended with 1941 are given in the table that follows. The figures for tonnage of ore sold or treated do not include magnetite ore containing pyrite and chalcopyrite, from which copper, gold, and silver were recovered as byproducts.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1937–41, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons) [1]	Gold (lode and placer) [2]		Silver (lode and placer) [3]	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	39	40	3,407,883	10,680.90	$373,832	106,873	$82,667
1938	51	26	3,159,880	19,928.00	697,480	94,945	61,380
1939	47	24	3,409,619	17,414.00	609,490	94,083	63,862
1940	40	18	3,674,815	18,456.00	645,960	102,825	73,120
1941	43	14	3,780,397	21,982.00	769,370	106,051	75,414

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1937	24,444,000	$2,957,725	5,539	$653,602	189,353	$24,894,159	$28,961,985
1938	21,079,160	2,065,758	7,900	726,800	172,501	19,211,235	22,762,653
1939	21,295,000	2,214,680	6,284	590,696	180,955	21,100,174	24,578,902
1940	25,490,000	2,880,370	4,831	483,100	178,815	24,135,445	28,217,995
1941	27,132,000	3,201,576	5,513	628,482	191,310	29,484,423	34,159,265

[1] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[2] Includes placer gold as follows 1937, 632 ounces; 1938, 667 ounces; 1939, 413 ounces, 1940, 452 ounces; 1941, 203 ounces
[3] Placer silver did not exceed 39 ounces in any year during the 5-year period.

Gold. The old Haile mine in Lancaster County, S. C., near Kershaw, yielded 69 percent of the total mine output of gold in the Eastern States in 1941. Other substantial producers were the Condor (old Howie) mine near Waxhaw, Union County, N. C.; and the Cornwall mine in Lebanon County, Pa., which yields gold, silver, and copper as a byproduct of iron mining. Changes in output of gold in the various States in 1941 comprised increases of 2,432 ounces in South Carolina, 1,301 ounces in North Carolina, 582 ounces in Pennsylvania, 54 ounces in Tennessee, and 25 ounces in Alabama; and decreases of 650 ounces in Georgia and 218 ounces in Virginia. The estimated output of gold in the Southern Appalachian States from 1799 to 1941 is recorded as follows:

Mine production of gold in the Southern Appalachian States, 1799–1941

State	Period	Fine ounces	Value	State	Period	Fine ounces	Value
Alabama	1830–1941	49,488	$1,198,740	South Carolina	1829–1941	310,830	$7,283,140
Georgia	1830–1941	870,479	18,082,612	Tennessee	1831–1941	20,038	448,960
Maryland	([1])–1941	6,102	163,940	Virginia	1828–1941	167,255	3,566,904
North Carolina	1799–1941	1,160,359	24,179,828	Total	1799–1941	2,584,551	54,924,124

[1] Year of first production not recorded.

Silver.—The silver recovered from ores and gravels mined in the Eastern States in 1941 totaled 106,051 fine ounces—59,221 ounces derived from copper and iron (magnetite-pyrite-chalcopyrite) ores, 37,734 ounces from zinc-lead ores, 9,081 ounces from gold ores, and 15 ounces from placer gravel.

Copper.—As the three mines that produced nearly all the copper output of the Eastern States in 1941 are in different States (North Carolina, Pennsylvania, and Tennessee), it is not possible to show the production separately by States without disclosing that of each mine; the combined output of the three States is shown under Tennessee in the following table. The total Eastern States production rose from 25,490,000 pounds in 1940 to 27,132,000 pounds in 1941. Gold ore from South Carolina and North Carolina yielded 1,265 pounds of copper. Copper ore yielded, in recovered metals, about 0.0004 ounce of gold and 0.06 ounce of silver to the ton of crude ore. Copper concentrates from the magnetite-pyrite-chalcopyrite ore of the Cornwall mine in Pennsylvania contained some recoverable gold and silver.

Lead.—The recoverable lead in concentrates shipped from mines in the Eastern States totaled 5,513 tons in 1941, an increase of 682 tons over 1940. The figures include some concentrates that were stock-piled at the mine in previous years and are credited to production for 1941, the year of shipment. Zinc-lead sulfide ores from the Austinville mine in Virginia and the Balmat in New York yielded all the lead output except 23 tons derived from lead carbonate and zinc-lead sulfide ores from Tennessee.

Zinc.—The mine output (shipments) of recoverable zinc in the Eastern States was 191,310 tons in 1941, an increase of 12,495 tons over 1940. New Jersey contributed 49 percent of the total in 1941, New York 20 percent, Tennessee 19 percent, and Virginia 12 percent. The Virginia shipments include a substantial tonnage of concentrates from mine stocks carried over from previous years. The newly developed Hyatt mine near Emeryville, N. Y., which began producing on a small scale in February 1941, and the Jarnagin mine at Jefferson City, Tenn., reopened in April, contributed part of the 7-percent increase in total output from the Eastern States during the year. Zinc ore yielded 73 percent of the total zinc output and zinc-lead ore and copper ore together 27 percent. The proximity of the large zinc mines of the Eastern States to smelting and manufacturing centers enhances their importance as a source of zinc in time of war, when transportation becomes a material factor in obtaining supplies. Statements furnished by mine operators early in December 1941 indicated an increase in production from their mines for 1942. The Government premium-price program announced January 12, 1942, provides an incentive for increasing the output from established mines and reopening marginal properties, and it may cause a larger gain.

MINE PRODUCTION BY STATES

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1941, by States, in terms of recovered metals

State	Mines producing		Ore (short tons)	Gold			Silver		
				Fine ounces		Total value	Fine ounces		Total value
	Lode	Placer		Lode	Placer		Lode	Placer	
Alabama	2		1,020	30		$1,050	3		$2
Georgia	7	11	1,641	122	189	10,885	24	14	27
New Jersey	2		585,463						
New York	3		488,079				37,734		26,833
North Carolina	5	2	33,746	3,238	6	113,540	7,438	1	5,290
Pennsylvania	1		(1)	2,422		84,770	15,016		10,678
South Carolina	7		135,288	15,508		542,780	6,525		4,640
Tennessee	13		2,033,030	227		7,945	39,161		27,848
Virginia	3	1	502,130	232	8	8,400	135		96
	43	14	[2] 3,780,397	21,779	203	769,370	106,036	15	75,414
Total, 1940	40	18	[2] 3,674,815	18,004	452	645,960	102,795	30	73,120

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Alabama							$1,052
Georgia							10,912
New Jersey					93,781	[3] $14,855,073	[3] 14,855,073
New York			2,100	$239,400	38,446	5,766,900	6,033,133
North Carolina	(4)	(4)					[5] 118,830
Pennsylvania	(4)	(4)					[5] 95,448
South Carolina	1,000	$118					547,538
Tennessee	[4] 27,131,000	[4] 3,201,458	23	2,622	36,170	5,425,500	[6] 8,665,373
Virginia			3,390	386,460	22,913	3,436,950	3,831,906
	27,132,000	3,201,576	5,513	628,482	191,310	29,484,423	34,159,265
Total, 1940	25,490,000	2,880,370	4,831	483,100	178,815	24,135,445	28,217,995

[1] Ore is magnetite-pyrite-chalcopyrite, flotation copper concentrates from which yielded gold, silver and copper; Bureau of Mines not at liberty to publish figures for ore and copper.
[2] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[3] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[4] North Carolina and Pennsylvania included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[5] Excludes value of copper, which is included under Tennessee.
[6] Includes also value of copper from North Carolina and Pennsylvania.

MINING INDUSTRY

The total output of ores yielding gold, silver, copper, lead, or zinc in the Eastern States in 1941, excluding the magnetite-pyrite-chalcopyrite ore from Pennsylvania, was 3,780,397 tons—a 3-percent increase over 1940. The quantity of gold-bearing sand and gravel handled at placer mines in the Southern Appalachian region was small; the Ferey Mining Co., only operator that reported using mechanical equipment in placer mining during the year, shut the equipment down in August after a few months of intermittent operation on the Barlow placer near Dahlonega, Ga. The gold ore output (most of which was treated by cyanidation) averaged $4.36 to the ton in gold and $0.04 in silver and copper. The copper, zinc, and

zinc-lead ores of the Eastern States yield byproducts (besides gold and silver), the value of which would have to be considered to show the full value of the crude ore mined. Copper-iron ore from Tennessee and zinc-lead-pyrite ore from New York yield pyrite concentrates that are used in the manufacture of sulfuric acid, and sulfuric acid is also made from gases produced in roasting zinc sulfide concentrates from zinc and zinc-lead ores of Tennessee, New York, and Virginia. New Jersey zinc ore yields a residue, which is further treated for the recovery of other metals; and zinc ore milled in Tennessee yields a commercial tailing, some of which is sold for its lime content and some for use in concrete. The quantity of the various types of ore mined in the Eastern States is shown in the table that follows.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in the Eastern States in 1941, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (short tons)	Zinc (short tons)
Dry and siliceous gold ore	152,833	19,033	9,081	1,265		
Copper ore	751,516	324	44,205	[1] 27,130,735		(2)
Magnetite-pyrite-chalcopyrite ore	(3)	2,422	15,016	(1)		
Lead ore	469				19	
Zinc ore	2,037,653					140,415
Zinc-lead ore	837,926		37,734		5,494	[2] 50,895
Total, lode mines	[4] 3,780,397	21,779	106,036	27,132,000	5,513	191,310
Total, placers		203	15			
	[4] 3,780,397	21,982	106,051	27,132,000	5,513	191,310
Total, 1940	[4] 3,674,815	18,456	102,825	25,490,000	4,831	178,815

[1] Copper from magnetite-pyrite-chalcopyrite ore included with that from copper ore.
[2] Zinc from copper ore included with that from zinc-lead ore, Bureau of Mines not at liberty to publish separate figures
[3] Bureau of Mines not at liberty to publish separate figures for ore and copper.
[4] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

METALLURGIC INDUSTRY

All the principal producing base-metal mines in the Eastern States except the Fontana copper mine in North Carolina have concentrating mills at or near the mines, but a considerable tonnage of copper ore is smelted direct and some of the crude zinc ore is shipped to oxide plants. The ore from the Fontana mine is shipped to the Tennessee Copper Co. plant in Tennessee. The methods of treatment used in the various mills and other operating details, including the tonnage and grade of concentrates produced by some of the mills, are given in the Review by States that follows. Most of the concentrates are shipped to smelters operated by the companies that own the mines. The methods of recovering the gold and silver are shown in the following table.

Mine production of gold and silver in the Eastern States in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Ore and old tailings amalgamated	3,348	418	173
Ore cyanided	149,123	18,323	8,831
Concentrates smelted [1]	75,778	2,649	91,911
Ore smelted [1]	19,764	389	5,121
Placer		203	15
		21,982	106,051
Total, 1940		18,456	102,825

[1] Excludes material containing no recoverable gold or silver. The totals for concentrates and direct-smelting ore shipped were 694,222 and 70,117 tons, respectively.

REVIEW BY STATES

ALABAMA

At the Hog Mountain mine near Alexander City, Tallapoosa County, 1,000 tons of old tailings from the mill dump were treated in 1941 by gravity concentration followed by amalgamation of the concentrates; the recovery was 28 fine ounces of gold and 3 fine ounces of silver. A lessee at the Gold Log mine near Talladega recovered 2 ounces of gold from about 20 tons of quartz treated by crushing, grinding, and amalgamation.

GEORGIA

Mines in Georgia yielded 311 fine ounces of gold and 38 fine ounces of silver in 1941, but no recoverable copper, compared with 961 ounces of gold, 630 ounces of silver, and 25,200 pounds of copper in 1940. The output in 1941 comprised 122 ounces of gold and 24 ounces of silver recovered from ore amalgamated at lode mines and 189 ounces of gold and 14 ounces of silver derived from placer gravel. The Ferey Mining Co. worked the Barlow placer near Dahlonega with a dragline and portable washing plant from March to August and produced about one-half of the State output of gold. Sluicing at small placers in Cherokee, Lumpkin, and White Counties recovered 32 ounces of gold. The Brand Estate claim in Cherokee County, the Findley and Lockhart mines in Lumpkin County, and the Russell mine in Paulding County were among the producing lode mines. All the Georgia output of gold and silver in 1941 was sold to the United States Mint at New Orleans, La. This mint discontinued purchasing newly mined gold and silver as of April 25, 1942.

NEW JERSEY

Zinc ore produced in New Jersey in 1941 totaled 585,463 tons containing 93,781 tons of recoverable zinc as metal or in oxide compared with 556,031 and 91,406 tons, respectively, in 1940. The producing mines were the Mine Hill at Franklin and the Sterling Hill at Ogdensburg, both in Sussex County. The ore bodies in these mines are unique in that they are said to be the only ones in the world from which all three of the minerals franklinite, willemite, and zincite are being mined in commercial quantities. The minerals, ore deposits, and mining methods are described in recent publications of the Geo-

logical Survey and the Bureau of Mines.[1] In the reduction of the ores the franklinite (an iron-manganese-zinc oxide mineral) is removed from the crushed ore by magnetic separators, and the willemite and zincite are concentrated on jigs and tables. The concentrates and some crude ore are shipped to smelters at Palmerton, Pa.

New Jersey has a few deposits of copper ore, but none has been worked for many years. At Carteret and Perth Amboy are copper and lead smelters and refineries that treat ores, scrap, byproducts, and bullion from various States and foreign countries.

NEW YORK

Zinc and zinc-lead ores mined in New York in 1941 yielded 38,446 tons of recoverable zinc, 2,100 tons of lead, and 37,734 fine ounces of silver—increases over 1940 of 2,760 tons in zinc, 127 tons in lead, and 2,014 ounces in silver. The producing mines in 1941 were the Balmat about 8 miles southeast of Gouverneur, the Edwards at the town of Edwards about 12 miles northeast of the Balmat, and the Hyatt near Emeryville, all in St. Lawrence County. The Balmat and Edwards mines are owned and operated by the St. Joseph Lead Co. The Balmat ore contains zinc, iron, and lead sulfides, and some silver is associated with the lead; it is mined through a 2,655-foot inclined shaft (vertical depth, about 1,300 feet) and treated in the selective flotation plant at the mine. The daily capacity of the mill at the end of 1941 was 1,100 tons. The mill feed in 1941 totaled 336,271 tons of ore; it yielded 3,578 tons of lead concentrates averaging 60.35 percent lead, 52,075 tons of zinc concentrates averaging 56.34 percent zinc, and 71,633 tons of pyrite concentrates averaging 41.35 percent iron and 49.39 percent sulfur. The lead concentrates contained considerable silver. The Edwards mine, which produces zinc ore, is opened by a vertical shaft to the 1,500-foot level and has an inclined shaft 1,212 feet long from this level to the lower workings. The mine is equipped with a 500-ton flotation mill, which treated 126,220 tons of ore yielding 21,421 tons of zinc concentrates averaging 58.71 percent zinc. The zinc concentrates from both mills were shipped to the company electrothermic zinc-reduction plant at Josephtown, Pa. The lead concentrates from the Balmat mill were shipped to the U. S. Metals Refining Co. plant at Carteret, N. J., and the pyrite concentrates were sold to sulfuric acid plants. The Hyatt zinc mine is owned by the Universal Exploration Co., which began developing it in 1938 and in 1940 nearly completed construction of a 200-ton flotation mill. The mill began treating ore early in 1941 and produced several cars of concentrates monthly from February through December; the concentrates were shipped to the Donora (Pa.) smelter.

NORTH CAROLINA

Gold production in North Carolina in 1941 totaled 3,244 fine ounces, and silver totaled 7,439 fine ounces, compared with 1,943 and 6,480 ounces, respectively, in 1940. Copper output from the Fontana

[1] Palache, Charles, The Minerals of Franklin and Sterling Hill, Sussex County, N. J.: Geol. Survey Prof Paper 180, 1935, 135 pp.
Jackson, Chas. F., Knaebel, John B., and Wright, C. A., Lead and Zinc Mining and Milling in the United States, Current Practices and Costs: Bureau of Mines Bull. 318, 1935, pp. 44, 134.

copper mine in Swain County—only producer of copper ore in the State during the year—varied little from that in 1940. The mine is operated by the North Carolina Exploration Co., which ships the crude ore to the Tennessee Copper Co. smelter at Copperhill, Tenn. The Fontana ore contains very small quantities of gold and silver, some of which are recovered as byproducts in refining the copper bullion. The Condor (old Howie) mine near Waxhaw in Union County, operated under lease by Hugh Jardine, was again the principal producer of gold in the State; milling of the ore at the Capps mill, Charlotte, was discontinued in January 1941, and a countercurrent cyanide mill was erected on the Condor property and operated continuously after July 15. Gold ore treated at this mill and copper ore from the Fontana mine yielded nearly all the silver output of the State during the year. A little gold was recovered from ore amalgamated at the Chapman property in Burke County and the Hoover Hill in Randolph County. A 28-ton lot of gold ore was shipped from a property near Ranger, Cherokee County, to the smelter at Copperhill. Small placers in Halifax and McDowell Counties yielded 6 fine ounces of gold and 1 fine ounce of silver.

PENNSYLVANIA

Gold, silver, and copper are recovered as byproducts of iron mining at the Cornwall mine of the Bethlehem Steel Co. in Lebanon County. The mine is developed by an open pit and three inclined shafts. The shafts were extended 200 feet during 1941 to a total depth of 1,500 feet. The ore contains magnetite, and pyrite and chalcopyrite carrying a little gold and silver; it is treated in the company plants at Lebanon, comprising a magnetic separation plant producing iron concentrates, a sintering plant for handling the iron concentrates, and a flotation mill in which the tailings from the magnetic plant are concentrated to recover copper, gold, and silver. The capacity of all three plants was expanded in 1941—that of the magnetic plant from 6,000 tons daily to 6,500 tons, the sintering plant from 2,000 to 2,400 tons, and the flotation plant from 2,500 to 2,800 tons. The rise in the production rate for iron resulted in an increase in the output of byproduct metals; the quantity of copper recovered rose 30 percent over 1940, gold 32 percent, and silver 15 percent.

SOUTH CAROLINA

In 1941, for the fifth consecutive year, South Carolina ranked first among the Eastern States in gold production. The old Haile mine in Lancaster County, 3½ miles northeast of Kershaw, continued to be the chief producer. The mine is equipped with a 400-ton cyanide plant, which was operated continuously in 1941. The ore is mainly quartz and pyrite; that produced in 1941 was mined from open pits. Ore treated during the year totaled 134,854 tons yielding 15,197 fine ounces of gold and 6,447 fine ounces of silver compared with 126,261 tons in 1940 yielding 12,861 ounces of gold and 7,970 ounces of silver. Other mines in the State yielded a total of 311 ounces of gold, 78 ounces of silver, and 1,000 pounds of copper in 1941. Small lots of gold were shipped to the Philadelphia Mint and the New York Assay Office from the Funder Bunk mine and the Mineral Mining Corporation properties in Lancaster County and the Oro at Pageland in

Chesterfield County. Crude ore containing gold and a little silver and copper was shipped from the Terry and Ross-Carroll mines near Smyrna, York County, to the U. S. Metals Refining Co. smelter at Carteret, N. J. W. K. Hunter, of Hickory Grove, shipped several cars of gold ore to the Tennessee Copper Co. smelter at Copperhill, Tenn.

TENNESSEE

The mine production of gold, silver, and zinc in Tennessee increased moderately in 1941 over 1940, copper decreased slightly, and lead declined sharply. The increase in zinc was the sixth in successive years, and the quantity produced (36,170 tons) was larger than in any previous year. The gold and silver and some of the zinc were byproducts of the copper-iron mining, milling, and smelting operations of the Tennessee Copper Co. at Ducktown and Copperhill in Polk County. Important commercial products derived from the copper-iron ores (besides copper bullion and zinc concentrates) included sulfuric acid and copper sulfate manufactured in the company plants and iron sinter sold to iron and steel producers, mostly in the Birmingham (Ala.) district. The zinc concentrates produced in the mills were sold to the Donora (Pa.) smelter. The new reverberatory furnace placed in operation at the company smelter in September 1940 was operated throughout 1941; the three blast furnaces formerly used for smelting were maintained as stand-by equipment. Most of the blister copper from the converter was cast into pigs and shipped to an electrolytic refinery on the Atlantic seaboard, where the byproduct gold and silver were recovered. Shot copper was produced for use at the copper sulfate plant. In 1941 the company operated the Burra Burra, Eureka, Isabella, and Boyd groups of mines and the London and Isabella selective flotation mills. The mines are opened by two vertical shafts 755 and 2,400 feet deep. Development work done during the year totaled 414 feet of shaft, 20,201 feet of drifts, and 28,077 feet of diamond drilling. The rated capacity of the London mill is 1,350 tons of ore daily and that of the Isabella 850 tons. In addition to crude ore and concentrates from company mines and mills the smelter treated considerable copper-iron sulfide ore from the Fontana mine in Swain County, N. C., and a small tonnage of gold ore from mines in North Carolina and South Carolina.

The principal zinc-producing mines in Tennessee in 1941 were the Mascot group in Knox County and the Grasselli, Jarnagin, and Davis groups in Jefferson County. The Jarnagin mine was reopened in April 1941 after having been closed since December 1937. The Mascot, Grasselli, and Jarnagin were operated by the American Zinc Co. of Tennessee, which concentrated the ore from all three mines in its Mascot mill. The mill is equipped with a differential-tension density unit, jigs, and flotation machines. In 1941 the mill treated 1,017,451 tons of ore yielding 44,537 tons of concentrates averaging 60.6 percent zinc. The Mascot mine is opened by a 520-foot shaft and an inclined shaft from the 520-foot level to the maximum depth of 850 feet. The Grasselli has one operating shaft and an auxiliary manway shaft and is 350 feet deep. Power-operated scrapers are used in both mines. The Jarnagin has one operating shaft 280 feet deep, with an auxiliary manway shaft. Development done in the three mines in 1941 totaled 355 feet of shaft, 5,763 feet of drifts, 7,325 feet

of diamond drilling, and 12,667 feet of churn drilling. The Davis group at Jefferson City is owned and operated by the Universal Exploration Co. The company 800-ton flotation mill for treating sulfide ore was operated at approximate capacity throughout 1941, and the 100-ton plant for concentrating carbonate ore was run at less than capacity from July to December. The average grade of the blende shipped in 1941 was 64.48 percent zinc. The Embree Iron Co., which owns properties in Washington and Unicoi Counties near Embreeville, operated its lead and zinc mines on a small scale from January to June, when production of these metals was suspended. In December the Imperial Mining Co. began operating the Imperial mine about 2 miles northwest of Goin, Claiborne County. The mill is equipped with a 4-cell jig. Production in 1941 was 35 tons of zinc-lead concentrates, shipped to the Ozark Smelting & Refining Co. plant at Coffeyville, Kans. Other output in the State in 1941 included a car of zinc ore from the Finchum property at New Market and a car of zinc concentrates shipped from Murfreesboro by an individual.

VIRGINIA

Virginia mines produced 240 fine ounces of gold and 135 fine ounces of silver in 1941 compared with 458 and 271 ounces, respectively, in 1940. No recoverable copper was produced in the State from 1939 to 1941, inclusive. The Red Bank mine near Virgilina, Halifax County, equipped with a small amalgamation mill, was the only lode mine in the State producing gold and silver in 1941; it was operated from January to July 18 by Joseph Hamme, owner, who then sold it to Red Bank Gold Mines, Inc., which made no output the rest of the year. A little gold was recovered from the Ruth placer in Goochland County.

The recoverable lead and zinc in concentrates shipped from Virginia in 1941 was 3,390 tons of lead and 22,913 tons of zinc, an increase of 1,105 and 5,986 tons, respectively, over 1940. A substantial part of the concentrates shipped in 1941 came from mine stocks accumulated in previous years. Actual mine production of both lead and zinc was less than in 1940. The Austinville zinc-lead mine of the New Jersey Zinc Co. in Wythe County, only large producer of lead and zinc in the State for many years, was operated continuously in 1941; it is equipped with a 2,000-ton flotation mill. The Lacy-Butler Co. shipped a car of zinc ore from a mine at Cripple Creek, Va.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

SUMMARY

The total value of gold, silver, copper, lead, and zinc produced by Idaho mines was $41,776,848 in 1941 compared with $37,744,393 in 1940—an increase of nearly 11 percent (see fig. 1). The quantity and total value of each metal except silver increased; the greatest gain was $2,966,874 in zinc. The value of the gold production represented nearly 13 percent of the State total, silver 28 percent, copper 2 percent, lead 29 percent, and zinc 28 percent. Production of gold in Idaho in 1941 (149,816 fine ounces) exceeded the 1940 production, which had been the largest since 1871, and the output of zinc (158,168,000 pounds) was by far the greatest in any year in the history of the State. Compared with 1940 the gold output increased 2 percent, copper 8 percent, lead less than one-half of 1 percent, and zinc 12 percent; silver declined 5 percent. The gain in gold output was due entirely to increased output from dredging at placer properties, as the output from lode mines decreased.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938–41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1937–41, and total 1863–1941, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	347	741	2,075,402	81,861	$2,865,135	19,587,766	$15,151,137
1938	305	463	1,999,147	103,513	3,622,955	18,993,676	12,278,740
1939	362	465	2,108,445	116,662	4,083,170	17,222,370	11,690,336
1940	378	548	2,556,687	146,480	5,126,800	17,552,240	12,481,593
1941	331	524	2,704,680	149,816	5,243,560	16,672,410	11,855,936
1863–1941			(1)	7,629,158	170,159,933	469,574,957	322,200,087

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	4,464,000	$540,144	207,422,000	$12,237,898	108,398,000	$7,045,870	$37,840,184
1938	4,278,000	419,244	184,354,000	8,480,284	88,060,000	4,226,880	29,028,103
1939	5,032,000	523,328	181,962,000	8,552,214	95,098,000	4,945,096	29,794,144
1940	6,698,000	756,874	209,668,000	10,483,400	141,202,000	8,895,726	37,744,393
1941	7,242,000	854,556	209,828,000	11,960,196	158,168,000	11,862,600	41,776,848
1863–1941	[2] 97,759	30,312,747	[2] 5,518,054	587,931,062	[2] 873,367	118,793,283	1,229,397,112

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Idaho, 1937–41, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating [1]		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1937	4,286	1,399	433	65	2,369	325	4,490	1,327	28,962	9,171	40,540	12,287
1938	4,987	969	410	57	1,989	384	15,459	5,818	31,234	10,100	54,079	17,328
1939	5,443	1,638	196	26	4,475	1,332	9,576	4,389	28,973	7,490	48,663	14,875
1940	6,664	1,337	291	48	5,623	758	6,569	5,427	41,262	10,226	60,409	17,796
1941	4,899	1,149	228	46	3,185	388	11,725	2,100	52,358	13,725	72,395	17,408

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline floating dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

Gold.—The output of recoverable gold in Idaho was 2 percent greater in 1941 than in 1940. The yield of gold from lode mines decreased 10 percent, and most of the loss was from gold ore; the production from placers increased 20 percent, owing to larger output from dredging. About 42 percent of the State total gold in 1941 came from siliceous gold ore and 45 percent from all types of dredging operations. Twelve floating (bucket) dredges, the same number as in 1940, treated 10,612,000 cubic yards of gravel and recovered 52,358 ounces of gold—an increase of 11,096 ounces over 1940; 9 dragline dredges and 12 dry-land dredges treated 2,342,000 cubic yards of gravel and recovered 14,910 ounces of gold—an increase of 2,718 ounces. Of the total placer gold, 84 percent came from the Boise Basin, Elk City, Yankee Fork, Warren, Hoodoo, Middle Boise, and Gibbonsville districts, where dredges were operated. Of the

total lode gold, 81 percent came from the Middle Boise, Yellow Pine, Warm Springs, Burgdorf-Marshall Lake, Carson, Yankee Fork, Mineral Hill, and West View districts and the Coeur d'Alene region. Substantial increases in output of gold were made in the Middle Boise, Yankee Fork, Elk City, Hoodoo, and Gibbonsville districts but large decreases in the Boise Basin and Yellow Pine districts and the Coeur d'Alene region.

Talache Mines, Inc., operating lode property at Atlanta, was again the largest gold producer in Idaho. It was followed by the Fisher-Baumhoff Co., which continued to operate two bucket dredges near Centerville; Yellow Pine mine at Stibnite; H. & H. bucket dredge near Elk City; Snake River Mining Co. (bucket dredge) at Sunbeam;

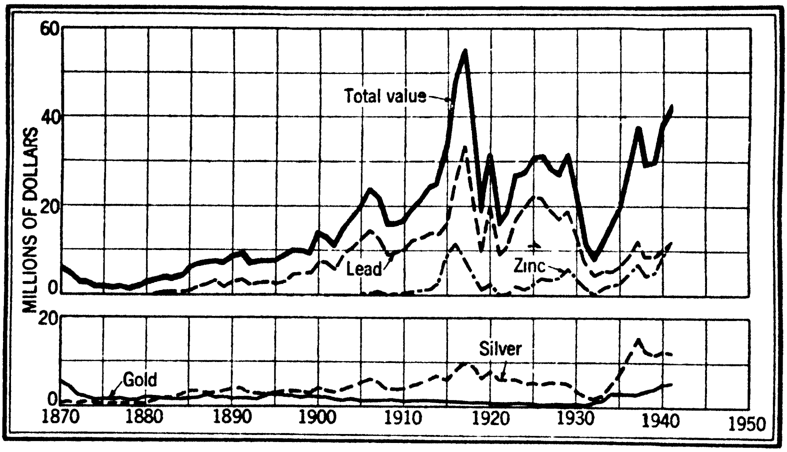

FIGURE 1 —Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1941 The value of copper has been less than $2,000,000 annually, except in a few years.

Golden Anchor mine at Burgdorf; Northwest Goldfields bucket dredge near Harvard; Triumph mine near Ketchum; Idaho-Canadian Dredging Co. at Idaho City; Warren Dredging Co. at Warren; Boise King Placers near Twin Springs; De Lamar Milling Corporation at De Lamar; and Custer Consolidated Mines, Inc., near Sunbeam.

Silver.—The output of recoverable silver in Idaho was 16,672,410 fine ounces in 1941—a 5-percent decrease from 1940. Production from the Sunshine mine declined 1,045,470 ounces. The Coeur d'Alene region produced 88 percent of the State total silver in 1941; the rest came largely from the Warm Springs, Carson, Bayhorse, South Mountain, Middle Boise, Port Hill, and Pend d'Oreille districts. Silver ore yielded 59 percent of the State total silver, zinc-lead ore 30 percent, lead ore 6 percent, and gold-silver ore and gold ore 3 percent. The yield of silver from silver ore decreased 918,449 ounces and from zinc-lead ore 418,176 ounces, but that from zinc ore increased 193,405 ounces, from lead ore 176,184 ounces, and from gold ore and gold-silver ore 60,176 ounces.

Eight mines—the Sunshine, Bunker Hill & Sullivan, Mineral Point, Polaris, Hecla, Morning, Triumph, and Page—produced 84 percent of the silver output of the State in 1941. All these mines except the Triumph are in the Coeur d'Alene region.

Copper.—The output of recoverable copper in Idaho in 1941 was 7,242,000 pounds—an 8-percent increase over 1940. The gain resulted mainly from increased output of silver-copper ore from the Mineral Point mine. Silver ore (chiefly from mines in the Coeur d'Alene region) yielded 68 percent of the State total copper, zinc-lead ore 17 percent, copper ore 9 percent, and lead ore and zinc ore together 5 percent.

The Mineral Point and Sunshine mines produced 63 percent of the total copper output of the State in 1941.

Lead.—The output of recoverable lead in Idaho was 209,828,000 pounds in 1941—an increase of only 160,000 pounds over 1940. Marked increases at the Sherman, Tamarack, and Sunset mines prevented a decline, as a notable decrease took place at the Morning mine. About 91 percent of the State total lead came from the Coeur d'Alene region and 5 percent from the Warm Springs district; considerable lead was produced also in the Port Hill, Bayhorse, and Pend d'Oreille districts. Zinc-lead ore and old tailings from the Coeur d'Alene region and the Warm Springs district yielded 86 percent of the State total lead; and lead ore, chiefly from the Coeur d'Alene region, yielded 13 percent. Lead recovered from zinc-lead ore declined 4,482,205 pounds and from silver ore 710,597 pounds, but that from lead ore increased 4,971,053 pounds and from zinc ore 408,589 pounds.

In 1941 the combined lead output of the three largest producers—the Bunker Hill & Sullivan, Morning, and Hecla—was 127,137,585 pounds (138,817,322 pounds in 1940), or nearly 61 percent of the State total; other important producers were the Page, Star, Triumph, Tamarack, Sherman, Idaho-Continental, Gold Hunter, and Clayton properties.

Zinc.—The output of recoverable zinc in Idaho was 158,168,000 pounds in 1941– a 12-percent increase over the former record output (in 1940). The gain was due principally to increased output of zinc from mines in the Coeur d'Alene region and in the Warm Springs and South Mountain districts. Substantial increases in zinc output were made at the Star, South Mountain, Triumph, Tamarack, Sunset, and Highland Surprise properties. More than 86 percent of the State total zinc in 1941 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs and South Mountain districts. Zinc-lead ore and old tailings concentrated yielded 97 percent of the State total zinc, and zinc ore concentrated nearly all the remainder.

Seven mines—the Star, Morning, Bunker Hill & Sullivan, Triumph, Hecla, Tamarack, and Page—produced 85 percent of the State total zinc in 1941; the rest came chiefly from the South Mountain, Frisco, Sunset, Interstate-Callahan, and Highland Surprise properties.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Ada	1	10	453	$15,855	31	$22
Adams	4	5	257	8,995	647	460
Bannock	1		1	35	7	5
Benewah		1	2	70		
Blaine	32	1	6,783	237,405	770,199	547,697
Boise	34	78	23,438	820,330	41,286	29,359
Bonner	6		13	455	76,365	54,304
Bonneville	1	5	78	2,730	7	5
Boundary	1				81,353	57,851
Butte	6		5	175	1,980	1,408
Camas	10	5	618	21,630	16,951	12,054
Canyon		2	3	105		
Cassia	3		11	385	76	54
Clearwater	2	42	1,968	68,880	457	325
Custer	30	11	12,803	448,105	297,457	211,525
Elmore	13	27	28,505	997,675	96,248	68,443
Gem	6	3	3,232	113,120	28,426	20,214
Idaho	58	152	37,016	1,295,560	39,171	27,855
Jerome		17	158	5,530	7	5
Latah		7	5,573	195,055	329	234
Lemhi	44	61	8,959	313,565	61,259	43,562
Lewis		7	51	1,785	7	5
Nez Perce		6	39	1,365	7	5
Owyhee	15	19	5,850	204,750	455,151	323,663
Power		2	18	630		
Shoshone	58	21	3,419	119,665	14,678,356	10,437,942
Twin Falls		27	202	7,070	17	12
Valley	4	11	10,346	362,110	21,299	15,146
Washington	2	4	15	525	5,317	3,781
	331	524	149,816	5,243,560	16,672,410	11,855,936
Total, 1940	378	548	146,480	5,126,800	17,552,240	12,481,593

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada							$15,877
Adams	37,000	$4,366	100	$6			13,827
Bannock	300	35					75
Benewah							70
Blaine	217,000	25,606	10,737,900	612,060	17,080,000	$1,281,000	2,703,768
Boise	4,000	472	36,300	2,069	12,000	900	853,130
Bonner	4,600	543	820,000	46,740			102,042
Bonneville	100	12					2,747
Boundary	19,500	2,301	3,074,000	175,218			235,370
Butte	5,600	661	75,000	4,275	2,000	150	6,669
Camas	8,900	1,050	68,300	3,893			38,627
Canyon							105
Cassia			1,600	91			530
Clearwater							69,205
Custer	450,500	53,159	2,895,400	165,038	28,000	2,100	879,927
Elmore			400	23			1,066,141
Gem	10,000	1,180	154,600	8,812			143,326
Idaho	11,000	1,298	16,000	912			1,325,625
Jerome							5,535
Latah							195,289
Lemhi	262,500	30,975	594,400	33,881	2,000	150	422,133
Lewis							1,790
Nez Perce							1,370
Owyhee	246,000	29,028	287,000	16,359	4,402,000	330,150	903,950
Power							630
Shoshone	5,957,000	702,926	191,057,000	10,890,249	136,642,000	10,248,150	32,398,932
Twin Falls							7,082
Valley	200	24	6,000	342			377,622
Washington	7,800	920	4,000	228			5,454
	7,242,000	854,556	209,828,000	11,960,196	158,168,000	11,862,600	41,776,848
Total, 1940	6,698,000	756,874	209,668,000	10,483,400	141,202,000	8,895,726	37,744,393

Gold and silver produced at lode mines in Idaho in 1941, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver	County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*
Ada	40	6		Custer	59,033	5,208	294,487
Adams	294	241	647	Elmore	122,399	23,429	94,576
Bannock	1	1	7	Gem	11,737	2,621	28,357
Blaine	104,870	6,781	770,199	Idaho	37,240	12,659	33,591
Boise	6,885	2,616	35,768	Lemhi	68,622	4,741	60,899
Bonner	10,728	13	76,365	Owyhee	98,444	5,099	454,843
Bonneville	1	1	7	Shoshone	2,051,390	3,056	14,678,287
Boundary	37,000		81,353	Valley	90,149	10,289	21,285
Butte	2,673	5	1,980	Washington	157	9	5,317
Camas	2,588	601	16,944				
Cassia	28	11	76		2,704,680	77,421	16,655,002
Clearwater	401	34	14	Total, 1940	2,556,687	86,071	17,534,444

Gold and silver produced at placer mines in Idaho in 1941, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges: Dry-land [1]		Dredges: Dragline floating [1]		Dredges: Floating bucket		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Ada	31	7			416	24					447	31
Adams	16										16	
Benewah	2										2	
Blaine	2										2	
Boise	2,142	493	13	3	74	22	1,058	303	17,535	4,697	20,822	5,518
Bonneville	77										77	
Camas	17	7									17	7
Canyon	3										3	
Clearwater	116	26			49	6	1,095	288	674	123	1,934	443
Custer	28	12					70	19	7,497	2,939	7,595	2,970
Elmore	178	52							4,898	1,620	5,076	1,672
Gem	16	3					595	66			611	69
Idaho	902	204	64	8	796	116	6,895	1,271	15,700	3,981	24,357	5,580
Jerome	158	7									158	7
Latah	23								5,550	329	5,573	329
Lemhi	469	42	46	7	1,187	122	2,012	153	504	36	4,218	360
Lewis	51	7									51	7
Nez Perce	39	7									39	7
Owyhee	282	242			469	66					751	308
Power	18										18	
Shoshone	64	9	105	28	194	32					363	69
Twin Falls	202	17									202	17
Valley	57	14									57	14
Washington	6										6	
	4,899	1,149	228	46	[2] 3,185	[2] 388	[3] 11,725	[3] 2,100	[4] 52,358	[4] 13,725	72,395	17,408
Total, 1940	6,664	1,337	291	48	5,623	758	6,569	5,427	41,262	10,226	60,409	17,796

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline floating dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

[2] Recovered from 342,000 cubic yards of gravel treated by 12 dry-land dredges.

[3] Recovered from 2,000,000 cubic yards of gravel treated by 9 dragline floating dredges.

[4] Recovered from 10,612,000 cubic yards of gravel treated by 12 floating bucket dredges

MINING INDUSTRY

The marked increase in output of zinc, the gain in production of gold from dredging operations, and the reopening of several old zinc-lead producers in the Coeur d'Alene region were the most important features of the mining industry of Idaho in 1941. The production of

zinc was the largest in any year in the history of the State, and the output of placer gold was the largest since 1872, when 77,884 fine ounces were produced. Zinc-lead ore (by far the chief output of the State) increased 3 percent over 1940, silver ore nearly 7 percent, gold-silver ore 29 percent, copper ore 62 percent, lead ore 29 percent, and zinc ore from 101 to 22,551 tons; gold ore declined 7 percent.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Idaho in 1941, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	172	330, 354	62, 657	245, 418	33, 077	242, 165	------------
Dry and siliceous gold-silver ore	16	82, 465	5, 566	296, 475	6, 649	51, 954	------------
Dry and siliceous silver ore	31	490, 691	433	9, 869, 309	4, 951, 766	955, 543	------------
	[1] 217	903, 510	68, 656	10, 411, 202	4, 991, 492	1, 249, 662	------------
Copper ore	15	7, 979	696	43, 851	687, 128	21, 913	------------
Lead ore	57	212, 251	426	1, 043, 250	139, 760	27, 154, 356	3, 600
Lead-copper ore	3	174	2	22, 227	13, 006	70, 497	------------
Zinc ore	10	22, 551	378	193, 484	204, 300	408, 589	4, 965, 172
Zinc-lead ore	37	1, 558, 215	7, 263	4, 940, 988	1, 206, 314	180, 922, 983	153, 199, 228
Total, lode mines	[1] 331	2, 704, 680	77, 421	16, 655, 002	7, 242, 000	209, 828, 000	158, 168, 000
Total, placers	524	------	72, 395	17, 408	------------	------------	------------
	855	2, 704, 680	149, 816	16, 672, 410	7, 242, 000	209, 828, 000	158, 168, 000
Total, 1940	926	2, 556, 687	146, 480	17, 552, 240	6, 698, 000	209, 668, 000	141, 202, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Of the 2,704,680 tons of ore produced in 1941 in Idaho, 2,492,644 tons (92 percent) were treated at concentration plants, 179,503 tons (7 percent) were treated at amalgamation and cyanidation mills, and 32,533 tons (1 percent) were shipped crude to smelters.

Ore treated at concentration plants in 1941 comprised 145,840 tons of gold ore, 81,202 tons of gold-silver ore, 480,902 tons of silver ore, 3,906 tons of copper ore, 200,387 tons of lead ore, 22,313 tons of zinc ore, and 1,558,094 tons of zinc-lead ore.

Ore treated at straight amalgamation mills in 1941 totaled 15,673 tons yielding 3,057 ounces of gold and 2,797 ounces of silver. Ore treated at combined amalgamation and concentration plants comprised 157,648 tons yielding 17,817 ounces of gold and 10,086 ounces of silver in amalgamation bullion and 2,570 tons of concentrates containing 18,065 ounces of gold, 167,010 ounces of silver, and some copper and lead.

Ore (6,182 tons) treated at straight cyanidation plants in 1941 yielded 659 ounces of gold and 1,486 ounces of silver.

The lead smelter and refinery of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley were operated continuously in 1941 on ore and concentrates, chiefly from the Bunker Hill & Sullivan,

Hecla, Star, Sunshine, Coeur d'Alene Mines Corporation, Polaris, Idaho-Continental, Gold Hunter, and Crescent mines, and zinc residue from the electrolytic zinc plant of the Sullivan Mining Co. The 100-ton electrolytic zinc plant of the Sullivan Mining Co. near Bradley operated at capacity, chiefly on zinc concentrates from the Star, Bunker Hill & Sullivan, and Hecla mills.

The Bunker Hill & Sullivan Mining & Concentrating Co. started building a fuming plant at Bradley in September to treat hot current slag and old slag containing principally zinc; this plant is expected to be operating in July 1942. The company also added to its milling plant a 1,700-ton H. & H. sink-and-float unit. The 400-ton gold mill at the Yellow Pine property at Stibnite was converted in August into a 200-ton mill to recover chiefly tungsten and antimony.

Mine production of metals in Idaho in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	173,321	20,874	12,883			
Ore cyanided	6,182	659	1,486			
Concentrates smelted	353,372	51,396	16,091,846	6,627,749	201,796,985	158,030,826
Ore smelted	32,533	4,492	548,787	614,251	8,031,015	137,174
Placer		72,395	17,408			
		149,816	16,672,410	7,242,000	209,828,000	158,168,000
Total, 1940		146,480	17,552,240	6,698,000	209,668,000	141,202,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1941, by types of mills and by counties, in terms of recovered metals

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
AMALGAMATION MILLS								
Ada	40	6						
Boise	2,699	1,191	521	9	52	146		
Clearwater	1	1						
Custer	15,997	1,502	1,690	188	2,727	53,183		
Elmore	121,426	10,384	6,117	2,117	12,852	87,700		
Idaho	23,053	6,542	3,603	256	2,434	25,981	8,500	3,300
Lemhi	717	208	40					
Owyhee	16	45	64					
Shoshone	72	65	17					
Valley	9,300	930	831					
	173,321	20,874	12,883	2,570	18,065	167,010	8,500	3,300
Total, 1940	127,152	19,741	11,035	2,044	13,848	131,171	119,673	7,300
CYANIDATION MILLS								
Blaine	3,000	314	1,291					
Cassia	17	4						
Clearwater	400	33	14					
Elmore	165	19	20					
Lemhi	2,600	289	161					
	6,182	659	1,486					
Total, 1940	15,305	2,228	4,607					
Grand total: 1941	179,503	21,533	14,369	2,570	18,065	167,010	8,500	3,300
1940	142,457	21,969	15,642	2,044	13,848	131,171	119,673	7,300

Mine production of metals from concentrating mills in Idaho in 1941, by counties, in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	97, 609	35, 881	5, 583	748, 126	212, 086	10, 618, 791	16, 994, 306
Boise	3, 502	155	364	1, 570	2, 142	12, 662	12, 000
Bonner	10, 553	760	9	61, 351	2, 700	697, 084	
Boundary	37, 000	2, 223		81, 353	19, 500	3, 074, 000	
Butte	2, 500	73		1, 118		71, 000	
Camas	650	8	72	37		100	
Custer	37, 558	2, 010	68	127, 685	18, 440	2, 399, 840	
Elmore	700	8	75	590			
Gem	11, 674	2, 088	2, 577	27, 620	9, 923	149, 648	
Idaho	14, 149	164	3, 575	3, 897	2, 500	12, 700	
Lemhi	63, 847	2, 266	3, 806	48, 008	237, 479	130, 225	
Owyhee	97, 928	5, 372	4, 961	440, 105	200, 000	276, 545	4, 402, 000
Shoshone	2, 034, 156	295, 607	2, 918	14, 363, 379	5, 914, 279	184, 347, 890	136, 622, 520
Valley	80, 818	4, 187	9, 323	19, 997	200	3, 200	
	2, 492, 644	350, 802	33, 331	15, 924, 836	6, 619, 249	201, 793, 685	158, 030, 826
Total, 1940	2, 368, 572	333, 960	41, 770	16, 652, 596	5, 732, 861	199, 559, 904	141, 202, 000

Gross metal content of concentrates produced from ores mined in Idaho in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	9,910	37,693	221,509	30,825	211,880	
Dry gold-silver	375	4,575	252,716			
Dry silver	76	9	4,199	333	7,209	
Copper	15,805	601	9,672,187	5,690,572	403,078	
Lead	147,318	2,984	5,085,001	867,105	198,153,059	16,668,853
Lead-copper	1,667	549	213,104	151,200	416,328	501,565
Zinc	162,190	1,630	577,890	723,095	9,648,467	172,992,907
Zinc-lead	2,562	42	29,551	9,570	707,482	2,255,360
Dry iron (from zinc-lead ore)	13,469	3,313	35,689	23,704	478,427	502,518
	353,372	51,396	16,091,846	7,496,404	210,025,930	192,921,203
Total, 1940	336,004	55,618	16,783,767	6,549,361	208,367,276	176,675,065

Mine production of metals from Idaho concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	35,881	5,583	748,126	212,086	10,618,791	16,994,306
Boise	164	416	1,716	2,142	12,662	12,000
Bonner	760	9	61,351	2,700	697,084	
Boundary	2,223		81,353	19,500	3,074,000	
Butte	73		1,118		71,000	
Camas	8	72	37		100	
Custer	2,198	2,795	180,868	18,440	2,399,840	
Elmore	2,125	12,927	88,290			
Gem	2,088	2,577	27,620	9,923	149,648	
Idaho	420	6,009	29,878	11,000	16,000	
Lemhi	2,266	3,806	48,008	237,479	130,225	
Owyhee	5,372	4,961	440,105	200,000	276,545	4,402,000
Shoshone	295,607	2,918	14,363,379	5,914,279	184,347,890	136,622,520
Valley	4,187	9,323	19,997	200	3,200	
	353,372	51,396	16,091,846	6,627,749	201,796,985	158,030,826
Total, 1940	336,004	55,618	16,783,767	5,852,534	199,567,204	141,202,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	9,910	37,693	221,509	23,645	182,590	
Dry gold-silver	375	4,575	252,716			
Dry silver	76	9	4,199	200	7,000	
Copper	15,805	601	9,672,187	5,057,802	382,545	
Lead	147,318	2,984	5,085,001	722,670	190,788,688	
Lead-copper	1,667	549	213,104	117,768	395,103	
Zinc	162,190	1,630	577,890	673,596	8,991,230	155,999,274
Zinc-lead	2,562	42	29,551	8,930	664,441	2,031,552
Dry iron (from zinc-lead ore)	13,469	3,313	35,689	23,138	385,388	
	353,372	51,396	16,091,846	6,627,749	201,796,985	158,030,826

Gross metal content of Idaho crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	5, 011	2, 784	8, 109	7, 942	71, 886	
Dry and siliceous gold-silver	1, 263	991	43, 759	9, 046	71, 284	
Dry and siliceous silver	9, 789	84	146, 647	20, 588	500, 059	
Copper	4, 073	441	43, 531	526, 608	32, 022	
Lead	11, 864	188	282, 548	74, 179	7, 681, 350	
Lead-copper	174	2	22, 227	15, 427	73, 437	
Zinc	238	1	549	1, 432	3, 073	87, 479
Zinc-lead	121	1	1, 417		33, 551	80, 606
	32, 533	4, 492	548, 787	655, 222	8, 466, 662	168, 085
Total, 1940	45, 658	8, 484	735, 035	896, 871	10, 695, 300	

Mine production of metals from Idaho crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Adams	294	241	647	37, 000	100	
Bannock	1	1	7	300		
Blaine	4, 261	884	20, 782	4, 914	119, 109	85, 694
Boise	684	1, 009	33, 531	1, 858	23, 638	
Bonner	175	4	15, 014	1, 900	122, 916	
Bonneville	1	1	7	100		
Butte	173	5	862	5, 600	4, 000	2, 000
Camas	1, 938	529	16, 907	8, 900	68, 200	
Cassia	11	7	76		1, 600	
Custer	5, 478	911	111, 929	432, 060	495, 560	28, 000
Elmore	108	99	149		400	
Gem	63	44	737	77	4, 952	
Idaho	38	108	110			
Lemhi	1, 458	438	12, 690	25, 021	464, 175	2, 000
Owyhee	500	93	14, 674	46, 000	10, 455	
Shoshone	17, 162	73	314, 891	42, 721	6, 709, 110	19, 480
Valley	31	36	457		2, 800	
Washington	157	9	5, 317	7, 800	4, 000	
	32, 533	4, 492	548, 787	614, 251	8, 031, 015	137, 174
Total, 1940	45, 658	8, 484	735, 035	845, 466	10, 100, 796	

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	5, 011	2, 784	8, 109	7, 323	45, 011	
Dry and siliceous gold-silver	1, 263	991	43, 759	6, 649	51, 954	
Dry and siliceous silver	9, 789	84	146, 647	17, 441	443, 778	
Copper	4, 073	441	43, 531	508, 314	21, 913	
Lead	11, 864	188	282, 548	60, 725	7, 367, 838	
Lead-copper	174	2	22, 227	13, 006	70, 497	
Zinc	238	1	549	793	2, 494	68, 300
Zinc-lead	121	1	1, 417		27, 530	68, 874
	32, 533	4, 492	548, 787	614, 251	8, 031, 015	137, 174

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing: Lode	Mines producing: Placer	Ore sold or treated	Gold: Lode	Gold: Placer	Gold: Total	Silver: Lode	Silver: Placer	Silver: Total	Copper	Lead	Zinc	Total value
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ada County:													
Black Hornet	1		40	6		6							$210
Boise		1			3	3							105
Highland (Boise River)		5			18	18		7	7				635
Snake River		4			426	426		24	24				14,927
Adams County:													
Seven Devils	4		294	241		241	647		647	37,000	100		13,267
Snake River		5			16	16							560
Bannock County: Lago	1		1	1		1	7		7	300			75
Benewah County:													
Tyson Creek (Camas Cove)		1			2	2							70
Blaine County:													
Mineral Hill and Camas	16		4,683	533		533	15,234		15,234	2,600	67,000	13,000	34,589
Sawtooth (Vienna)	2		55	25		25	1,433		1,433		3,600		2,099
Warm Springs	14	1	100,132	6,223	2	6,225	753,532		753,532	214,400	10,667,300	17,067,000	2,667,080
Boise County:													
Banner	1	1	1	1	3	4	38		38				167
Boise Basin	22	56	1,493	1,211	20,671	21,882	33,262	5,483	38,745	1,500	23,300		794,927
Boise River (Twin Springs)		1			4	4							140
Eight Mile Creek	1		2,577	301		301	256		256	200	100		10,747
Garden Valley		2			6	6							210
Grimes Pass	3	8	568	134	87	221	1,222	21	1,243	2,300	12,900	12,000	10,525
Miller Creek		1			10	10		7	7				355
North Fork	1		15				540		540				384
Payette River		2			4	4							140
Rabbit Creek		2			27	27		7	7				950
Shaw Mountain	1		20	12		12	3		3				422
South Fork of Payette River		4			9	9							315
Summit Flat	5	1	2,211	957	1	958	447		447				33,848
Bonner County:													
Lakeview	1		1,053	8		8	4,019		4,019	200	7,000		3,561
Pend d'Oreille	5		9,675	5		5	72,346		72,346	4,400	813,000		98,481
Bonneville County: Mt. Pisgah	1	5	1	1	77	78	7		7	100			2,747
Boundary County: Port Hill	1		37,000				81,353		81,353	19,500	3,074,000		235,370
Butte County:													
Dome	1		2,500				1,118		1,118		71,000		4,842
Hamilton	1		13				24		24	4,600	200		571
Lava Creek	4		160	5		5	838		838	1,000	3,800	2,000	1,256

Camas County:													
Beaver Creek (Mineral Hill)	1		1,032	319		319	3,029		3,029	4,400	42,600		16,266
Little Smoky and Carrietown	6	5	893	52	17	69	13,797	7	13,804	4,500	25,600		14,221
Skeleton Creek	3		663	230		230	118		118		100		8,140
Canyon County: Snake River		2			3	3							105
Cassia County:													
Blackpine	2		22	4		4	62		62		200		195
Stokes	1		6	7			14		14		1,400		335
Clearwater County.													
Burnt Creek		3			12	12		7	7				425
Moose Creek and Independence Creek		6			63	63		7	7				2,210
North Fork of Clearwater River		2			3	3							105
Pierce	2	31	401	34	1,856	1,890	14	429	443				66,465
Custer County:													
Alder Creek	4		3,483	383		383	9,474		9,474	381,500	90,400	28,000	72,412
Bayhorse	8	2	38,409	45	2	47	221,182		221,182	68,600	2,755,300		324,077
Boulder	1		114	2		2	855		855		27,700		2,257
East Fork	1		6				83		83		3,400		253
Loon Creek	1	1	8	22	3	25	14		14	100			897
Seafoam	4		166	116		116	1,004		1,004		5,300		5,076
Stanley and Stanley Basin	2	4	648	138	90	228	3,167	28	3,195	300	13,300		11,045
Yankee Fork	9	4	16,199	4,502	7,500	12,002	58,708	2,942	61,650				463,910
Elmore County:													
Bear Creek	9	1	992	205	2	207	758		758		300		7,801
Boise River (Twin Springs)		8			43	43		14	14				1,515
Middle Boise	3	13	121,404	23,221	5,019	28,240	93,811	1,658	95,469				1,056,289
Neal	1		3	3		3	7		7		100		116
Snake River		5			12	12							420
Gem County: West View	6	3	11,737	2,621	611	3,232	28,357	69	28,426	10,000	154,600		143,326
Idaho County:													
Burgdorf-Marshall Lake	10	5	14,653	6,111	110	6,221	27,000	38	27,038	1,900	3,300		237,374
Camp Howard (Salmon River)		16			116	116		24	24				4,077
Clearwater River (Pardee)		3			3	3							105
Deep Creek		1			2	2							70
Dixie	7	10	520	231	272	503	128	59	187		100		17,744
Elk City	4	21	2,455	468	13,504	13,972	1,274	2,544	3,818				491,735
Florence and French Creek	2	34	5	9	125	134	7	45	52				4,727
Harpster		1			3	3							105
Lolo Creek		4			13	13							455
Lower Salmon River		4			84	84		14	14				2,950
Maggie and Pete King Creeks		1			4	4							140
Newsome		2			1,882	1,882		384	384				66,143
Orogrande	4	5	5,315	1,760	2,010	3,770	1,499	433	1,932	600	6,600		133,794
Ramey Ridge	4		2,555	840		840	782		782	6,600			30,735
Riggins		2			5	5							175
Robbins (Buffalo Hump)	4		2,606	593		593	1,080		1,080	1,100	4,800		21,927
Salmon River (Shoup)		10			42	42		7	7				1,475
Seven Devils		1			1	1							35
Simpson (Salmon River)		12			56	56		7	7				1,965
Snake River		6			54	54		7	7				1,895
Ten Mile	8	1	8,059	1,980	48	2,028	1,544	7	1,551	600	1,200		72,222
Warren	15	13	1,072	667	6,023	6,690	277	2,011	2,288				235,777

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Jerome County Snake River		17			158	158		7	7				$5,535
Latah County													
Gold Creek		2			3	3							105
Hoodoo		2			5,553	5,553		329	329				194,589
Moscow Mountain		3			17	17							595
Lemhi County:													
Blackbird	1		3,277	266		266	204		204	146,500			26,742
Blue Wing	1		29,035	11		11	45,661		45,661	55,000	116,700		45,997
Eldorado	2		10	21		21	121		121	4,200			1,317
Eureka	8	4	1,491	235	17	252	201		201	49,350	100		14,792
Gibbonsville (Dahlonega)	9	13	185	177	2,827	3,004	107	204	311	550	1,600		105,517
Indian Creek	1		2,001	412		412	38		38	1,500			14,624
Junction	2		10				128		128		5,600		410
Kirtley Creek		11			45	45		7	7				1,580
Mackinaw	1	16	14	21	1,200	1,221		128	128				42,826
Mineral Hill	4	2	28,220	2,893	7	2,900	1,838		1,838	700	12,700		103,614
Nicholia	1		8								300	2,000	167
Parker Mountain	1		8	15		15	73		73				577
Rattlesnake Creek	1		2				28		28		1,000		77
Salmon River		14			112	112		21	21				3,935
Spring Mountain	3		16				208		208	450	11,400		851
Texas	3		3,539	319		319	11,963		11,963	2,450	444,300		45,286
Yellow Jacket	6	1	806	371	10	381	329		329	1,800	700		13,821
Lewis County:													
Clearwater River (Kamiah)		4			8	8							280
Salmon River		3			43	43		7	7				1,510
Nez Perce County:													
Clearwater River		2			6	6							210
Snake River		4			33	33		7	7				1,160
Owyhee County:													
Carson or French	9	9	81,330	4,698	127	4,825	254,714	277	254,991				350,202
Castle Creek	3		4	3		3	111		111				184
Flint	1		1	1		1	149		149				141
Snake River		10			624	624		31	31				21,862
South Mountain	1		17,086	376		376	199,838		199,838	246,000	287,000	4,402,000	530,804
Steele	1		23	21		21	31		31				757
Power County. Snake River		2			18	18							630
Shoshone County:													
Beaver	9	9	73,770	106	252	358	117,104	45	117,149	66,500	4,344,800	7,048,600	879,982
Coeur d'Alene	1	3	72	19	27	46	7	7	14				1,620

Eagle	1	2	320	1	11	12	1,236		1,236	200	90,300	3,600	6,740
Evolution	7		451,690	325		325	9,581,130		9,581,130	4,818,300	622,900	381,600	7,457,307
Hunter	5		540,013	387		387	1,143,713		1,143,713	307,800	52,759,900	64,455,400	8,704,641
Lelande	10		298,216	478		478	1,267,771		1,267,771	272,700	45,664,400	16,318,400	4,777,186
Placer Center	6		123,088	200		200	275,189		275,189	70,000	12,202,400	12,284,400	1,827,817
St. Joe	2	3	9	6	6	12	7		7	800			519
Summit	3	4	3,094	731	67	798	571	17	588	700	24,400	26,400	31,802
Yreka	14		561,118	803		803	2,291,559		2,291,559	420,000	75,347,900	36,123,600	8,711,318
Twin Falls County Snake River		27			202	202		17	17				7,082
Valley County:													
Big Creek	1	2	160	93	5	98	197		197	200	3,200		3,776
Deadwood Basin		2			8	8							280
Lake City		2			18	18		7	7				635
Pistol Creek	1		31	36		36	457		457		2,800		1,745
South Fork of Salmon River		2			7	7							245
Thunder Mountain	1	3	9,300	930	19	949	831	7	838				33,811
Yellow Pine	1		[1] 80,658	9,230		9,230	19,800		19,800				337,130
Washington County:													
Snake River		4			6	6							210
Washington (Mineral Creek)	2		157	9		9	5,317		5,317	7,800	4,000		5,244
Total Idaho	331	524	2,704,680	77,421	72,395	149,816	16,655,002	17,408	16,672,410	7,242,000	209,828,000	158,168,000	41,776,848

[1] Exclusive of antimony-tungsten-gold ore.

ADA COUNTY

Black Hornet district.—Adelmann Bros. operated their mine a short time in 1941 and treated a little gold ore by amalgamation.

Highland (Boise River) district.—Placer gold and silver were recovered by sluicing in 1941 at various claims along the Boise River 12 miles east of Boise.

Snake River district.—There was a marked increase in output of placer gold in the Snake River district of Ada County in 1941, owing to operation of three dry-land dredges near Grand View; the largest production came from ground worked by Cecil Rhodes.

ADAMS COUNTY

Seven Devils district.—Lessees operated the Placer Basin mine near Cuprum in 1941 and shipped several cars of gold ore to a smelter; nearly all the remainder of the district output was copper ore from the Helena and South Peacock properties.

Snake River district.—Placer gold was recovered in 1941 by sluicing at various claims along the Snake River near Homestead.

BLAINE COUNTY

Mineral Hill and Camas district.—The output of the Mineral Hill and Camas district in 1941 was largely old tailings (gold) treated by cyanidation from the Daisy property, old tailings (silver) shipped from the Minnie Moore property, and gold ore and old tailings from the Camas property.

Sawtooth (Vienna) district.—About 35 tons of gold-silver ore was shipped from the Vienna mine in 1941 and a little silver ore from the Silver King mine.

Warm Springs district.—Except for the Coeur d'Alene region, the Warm Springs district near Ketchum continued to be the most important producing area in Idaho; the value ($2,667,080) of its metal output increased 14 percent in 1941 over 1940. Zinc-lead-silver ore (about 97,000 tons) from the Triumph-North Star-Independence groups was again the chief output of the district; the rest of the district output was principally gold ore and old tailings from the June Day property and gold-silver ore and lead ore from Boulder Basin Mines.

BOISE COUNTY

Banner district.—The only output of the Banner district in 1941 was old mill cleanings sold to an assayer in Boise and placer gold recovered from the Gold Fork claim.

Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—The production of ore and of each metal, especially gold and silver, in the Boise Basin district was less in 1941 than in 1940. The most important output was, as usual, placer gold from dredging operations, but gold from this source decreased 13 percent from 1940. The Fisher-Baumhoff Co., operating two bucket dredges at Centerville, was again the largest producer of placer gold in the State; the two dredges handled 2,529,000 cubic yards of gravel and recovered 12,007 fine ounces of gold. The Idaho-Canadian Dredging Co. operated its 7½-cubic foot bucket dredge at Idaho City throughout the

year and recovered more than 5,500 fine ounces of gold. Considerable gold was also recovered by two dragline floating dredges—one operated by M. A. Stickler on Moores Creek and the other by Smith Bros. on Grimes Creek—and by hydraulicking and sluicing at Gold Hill Placers at Idaho City. The most important lode operation in the district during 1941 was that of the Come-Back Mining Co.; this company operated its mine at Pioneerville continuously and shipped 192 tons of high-grade gold-silver ore to a smelter.

Eight Mile Creek district.—Birthday Consolidated Gold Mines, Inc., operated its mine near Lowman throughout 1941; about 2,400 tons of gold ore were treated in a 25-ton concentration plant, and 174 tons of crude ore were shipped to a smelter.

Grimes Pass district.—The output of the Grimes Pass district in 1941 was principally gold ore and zinc-lead ore from the Homestake-Coon Dog group, gold ore and lead ore from the Santa Clara mine, and placer gold chiefly from the J. S., Horseshoe, and Golden Age properties.

Miller Creek district.—Placer gold and silver were recovered in 1941 by sluicing at the Miller Mountain claim.

North Fork district.—In 1941 about 15 tons of silver ore were shipped from the Packer John claim near Smiths Ferry.

Rabbit Creek district.—Hydraulicking and sluicing at the Rabbit Creek Placer recovered a little gold and silver.

Shaw Mountain district.—The Little Dave mine was operated in 1941, and gold ore was treated by amalgamation.

South Fork of Payette River district.—Placer gold was recovered in 1941 by sluicing at various claims along the South Fork of the Payette River near Lowman.

Summit Flat district.—Virtually all the output in the Summit Flat district in 1941 was gold ore treated by amalgamation; 82 percent of the output came from the King mine.

BONNER COUNTY

Lakeview district.—The Hewer (Idaho Lakeview) mine was the only producer in the Lakeview district in 1941; several hundred tons of silver ore were treated in a 75-ton flotation plant.

Pend d'Oreille district.—In 1941, as in 1940, nearly all the output of the Pend d'Oreille district was silver-lead ore, treated by flotation, from the Hope (Elsie K.) and Whitedelf mines; however, the output from the Hope property was much less than in 1940. The Whitedelf mine was by far the most important producer in the district.

BONNEVILLE COUNTY

Virtually all the output of Bonneville County in 1941 was placer gold recovered by hydraulicking and sluicing, largely from the Rosana, Lottie, and McCoy Creek properties in the Mt. Pisgah district.

BOUNDARY COUNTY

In 1941, as in 1940, the only producer in Boundary County was the Idaho-Continental mine in the Port Hill district; 37,000 tons of silver-lead ore were treated by flotation.

BUTTE COUNTY

Dome district.—The output of the Dome district in 1941 was 2,500 tons of lead ore, treated by gravity concentration, from the mine dump at the Wilbert property.

Hamilton district.—Small lots of rich copper ore were produced in 1941 from the Copper Mountain prospect.

Lava Creek district.—Silver ore was produced in 1941 from the Hornsilver mine, silver-lead ore from the Lead Belt mine, gold-silver ore from the Moran mine, and zinc ore from the Multa Metals group.

CAMAS COUNTY

Beaver Creek (Mineral Hill) district.—Lessees operated the Princess-Blue Ribbon mine in 1941 and shipped 988 tons of gold ore and 44 tons of lead ore to smelters in Utah; the output was much less than in 1940.

Little Smoky and Carrietown district.—The output of the Little Smoky and Carrietown district in 1941 was chiefly silver ore and old tailings from the King of the West property, silver ore from the Horn Silver mine, and gold-silver-copper ore from the Grant mine.

Skeleton Creek district.—Lessees operated the El Oro mine in 1941 and treated about 600 tons of gold ore by gravity concentration. The remainder of the district output was principally high-grade gold ore from the Red Horse claim.

CASSIA COUNTY

Virtually all the output of Cassia County in 1941 was silver ore from the Silver Hills claim in the Blackpine district and gold-lead ore from the Big Bertha mine in the Stokes district.

CLEARWATER COUNTY

Burnt Creek district.—The output of the Burnt Creek district in 1941 was placer gold and silver; the chief producer was the Frank Bish claim near Elk River.

Moose Creek and Independence Creek district.—The output of placer gold in the Moose Creek and Independence Creek district increased in 1941, owing to operation, from June to October, of a dry-land dredge at the Alma claim by Placer Properties of Idaho, Inc.

Pierce district.—Production of placer gold in the Pierce district decreased nearly 45 percent in 1941 compared with 1940, owing to suspension of dredging by the Quartz Creek Dredging Co. in March. A greater decrease was prevented by the operation of two dragline floating dredges—one at the Crawford Placer by the J. M. S. Co. and the other at the French Creek Placers by the Pilot Dredging Co. Nearly all the gold output from lode mines in the district was produced from the Gold Quartz claim.

CUSTER COUNTY

Alder Creek district.—The principal output in the Alder Creek district in 1941 was copper ore, containing gold and silver, from the Empire mine at Mackay; however, the output declined from 4,500 tons in 1940 to 3,169 tons in 1941. The rest of the district output was largely lead ore from the Horseshoe mine and zinc ore and lead ore from the White Knob property.

Bayhorse district.—The value of the metal output of the Bayhorse

district was 35 percent greater in 1941 than in 1940, chiefly in consequence of the increase in output of silver and lead from the Clayton property. This mine was operated continuously, and 36,880 tons of silver-lead ore were treated by flotation. In November the company (Clayton Silver Mines) began to erect an addition to its mill building to house a zinc-recovery plant. Lessees continued to operate the Ramshorn mine and shipped 938 tons of lead-silver ore and lead-copper-silver ore. The rest of the district output was largely silver-lead ore from the Riverview and South Butte properties.

Boulder district.—Lessees continued to operate the Livingston mine and treated 114 tons of silver-lead ore by gravity concentration.

East Fork district.—A small lot of lead ore was produced in 1941 from the F. D. R. prospect.

Loon Creek district.—A little high-grade gold ore was produced in 1941 from the Last Chance claim and placer gold from the Brush claim.

Seafoam district.—There were four producers in the Seafoam district in 1941, but most of the output was crude gold ore from the Lake View mine.

Stanley and Stanley Basin district.—The decline in metal output in the Stanley and Stanley Basin district in 1941 resulted from suspension in April of production of crude gold-silver ore from property operated by the Western Gold Exploration Co. The company worked most of the year on development and in building a new 100-ton concentration and cyanidation plant. Placer gold and silver were recovered, largely from the Elk Creek Placer, by a dragline floating dredge.

Yankee Fork district.—The value of metal production in the Yankee Fork district in 1941 was $463,910—an increase of $294,912 over 1940. The principal output was placer gold from the Yankee Fork Placer and lode gold and silver from the General Custer-Lucky Boy group. The marked increase in placer gold resulted from regular operation of the 8-cubic foot bucket dredge of the Snake River Mining Co. at the Yankee Fork property. About 16,000 tons of gold ore from the General Custer-Lucky Boy group were treated by amalgamation and concentration.

ELMORE COUNTY

Bear Creek district.—Gold ore was produced in 1941, chiefly from the Avalanche-Richmond, Luck, Duces Wild, and Jungo properties.

Boise River (Twin Springs) district.—Small-scale placer operators along the Boise River near Twin Springs recovered 43 fine ounces of gold and 14 fine ounces of silver in 1941.

Middle Boise (Atlanta) district.—The value of the metal output of the Middle Boise district increased to $1,056,289 in 1941, owing to substantial gain in output of gold from the Boise-Rochester-Monarch groups and to operation of a new 7½-cubic foot bucket dredge by Boise King Placers. Talache Mines, Inc., operated its property (Boise-Rochester-Monarch) continuously and treated 121,355 tons of gold ore by amalgamation and concentration; this property, with a production of 23,027 fine ounces of gold in 1941, remained the chief producer of gold in Idaho. Boise King Placers became a large producer of placer gold through operation, from June 15 to December 31, of a bucket-line dredge.

Snake River district.—Placer gold was recovered in 1941 by various operators along the Snake River near King Hill.

GEM COUNTY

West View district.—The principal output of the West View district in 1941 was lode gold and silver from the Lincoln group and placer gold from the Cruickshank property. Huron Mines, Inc., operated the Lincoln group and treated 11,274 tons of gold ore by flotation. A dragline floating dredge at the Cruickshank property recovered about 600 fine ounces of gold and 66 fine ounces of silver; the equipment was moved in June to a property near Idaho City, Boise County.

IDAHO COUNTY

Burgdorf-Marshall Lake district.—Gold ore from the Golden Anchor mine was again the chief output of the Burgdorf-Marshall Lake district, but the output declined from 15,459 tons in 1940 to 13,367 tons in 1941. Other producers of gold ore included the Gold Crest, Jewel, Kimberly, Old Kentuck, and Warrior properties. Nearly all the output of placer gold and silver was recovered by hydraulicking and sluicing at the Ruby placers and the Black Creek and Golden Rule properties.

Camp Howard (Salmon River) district (White Bird).—Hydraulicking and sluicing and drift mining at various claims along the Salmon River near White Bird recovered 116 fine ounces of gold and 24 fine ounces of silver in 1941.

Dixie district.—The principal output of the Dixie district in 1941 was placer gold recovered by a dragline floating dredge at Dixie Placers and lode gold, mostly from the Slip Easy, Dixie Royal, Ontario, and North Star properties.

Elk City district.—In 1941 six dredges in the Elk City district treated 1,796,883 cubic yards of gravel and recovered 13,387 fine ounces of gold and 2,525 fine ounces of silver, nearly double the output in 1940; the bucket-line dredge on Crooked River, operated by H. & H. Mines, was by far the largest producer. Other large producers were the American River Mining Co., Tyee Mining Co., and Lloyd Barker. Nearly all the lode gold produced in the district in 1941 came from gold ore and old tailings amalgamated at the Blue Ribbon property, operated by the Elk Leasing Corporation.

Florence and French Creek district.—Numerous small lots of placer gold and silver were recovered by operators in the Florence and French Creek district in 1941, and a little lode gold and silver was produced from the Golden Dyke and Sines claims.

Lolo Creek district.—Thirteen fine ounces of placer gold were recovered in 1941 from gravel along Lolo Creek.

Lower Salmon River district.—The output of the Lower Salmon River district in 1941 was placer gold and silver, recovered chiefly from the Swiftwater and Sunshine properties.

Newsome district.—Gold output in the Newsome district was much greater in 1941 than in 1940, owing to the operation of a dragline floating dredge at property on Newsome Creek by Gold Hill Placers.

Orogrande district.—The Mt. Vernon Co. operated its 2-cubic foot bucket dredge at property on Crooked River 9 months of the year and recovered about 2,000 fine ounces of gold and 430 fine ounces of silver. Nearly all the remainder of the district output was gold and silver produced from the Penman lode mine.

Ramey Ridge district.—Snowshoe Gold, Inc., operated the Snowshoe

mine in 1941; about 2,500 tons of gold ore were treated by amalgamation and concentration. The rest of the district output was small lots of gold ore from the Estep, Hand, and Werdenhoff properties.

Robbins (Buffalo Hump) district.—The output of the Robbins district in 1941 was gold ore, principally from the Jumbo, St. Louis, and Mother Lode properties.

Salmon River (Shoup) district.—Small-scale placer operators recovered 42 fine ounces of gold and 7 fine ounces of silver in 1941 at various bars along the Salmon River in Idaho County below Shoup.

Simpson (Salmon River) district (Lucile).—The principal producers of placer gold in the Simpson district in 1941 were the Wild Cat, Betty Jean, Katie B., and J. K. T. properties.

Snake River district.—Sluicing at various claims on the Snake River below Lewiston recovered 54 fine ounces of gold and 7 fine ounces of silver in 1941.

Ten Mile district (Golden).—Lessees operated the Center Star mine throughout 1941 and treated about 6,800 tons of gold ore by concentration; this mine was by far the most important producer in the district. Other producers of gold ore included the Bob, Lone Pine, Shamrock, and Wonder properties. Placer gold and silver were recovered by hydraulicking and sluicing at Key Placers.

Warren district.—Gold output in the Warren district declined to 6,690 fine ounces in 1941, owing to decreased output of gold from bucket dredging. The Warren Dredging Co., largest producer in the district, operated two bucket dredges from January 1 to August 10, when it sold its placer ground and one dredge to W. W. Prather, who operated the property the remainder of the year. Production of gold from lode mines in the district came mainly from the Rescue property.

JEROME COUNTY

Production from Jerome County in 1941 was, as usual, placer gold and silver recovered by various operators along the banks of the Snake River near Murtaugh, Hansen, Eden, and Twin Falls.

LATAH COUNTY

Hoodoo district.—The output of the Hoodoo district in 1941 was placer gold and silver, virtually all recovered by the 4½-cubic foot bucket-line dredge of Northwest Goldfields.

Moscow Mountain district.—The output of 17 fine ounces of placer gold in the Moscow Mountain district in 1941 was recovered chiefly from Leith Placer.

LEMHI COUNTY

Blackbird district.—The Uncle Sam mine was the only producer in the Blackbird district in 1941; 3,256 tons of copper ore were treated by flotation, and 21 tons of copper ore were shipped crude to a smelter.

Blue Wing district.—About 29,000 tons of ore from the Ima mine containing galena, pyrite, and certain strategic minerals were treated in 1941. Iron concentrates containing gold, silver, copper, and lead were shipped to a smelter in Utah.

Eldorado district.—A small lot of copper ore was produced in 1941 from the Mountainview claim, and some old mill cleanings (gold) from the Ranger mill were sold to an assayer.

Eureka district.—The principal output in the Eureka district in 1941 was gold ore (amalgamated) from the Queen of the Hills mine and copper ore (concentrated) from the Pope-Shenon and Grand View properties.

Gibbonsville district.—Output of placer gold in the Gibbonsville district showed a marked increase in 1941, owing to the operations of two dredges. A dragline floating dredge was operated by Smith Bros. at the Hagle property, and a 4½-cubic foot bucket-line dredge was operated the last quarter of the year at Hughes Creek Placer by the Idaho-Warren Dredging Co.; Smith Bros. was by far the larger producer. Hydraulicking and sluicing at the Sundown property recovered considerable placer gold. Most of the gold output from lode mines in the district came from the Nevada, McCarthy, and Providencia properties.

Indian Creek district.—The output of the Indian Creek district in 1941 was gold ore (concentrated) from the Kittie Burton & Ulysses group.

Junction district.—A little lead ore was produced in 1941 from the Dirigo and Plymouth properties near Leadore.

Kirtley Creek district.—In 1941, 45 fine ounces of gold and 7 fine ounces of silver were recovered by drift mining by various placer operators on Kirtley Creek.

Mackinaw district.—The principal output of the Mackinaw district in 1941 was placer gold from the Richardson property at Leesburg, where a 1¾-cubic yard dry-land dredge recovered more than 1,000 fine ounces of gold and 115 fine ounces of silver.

Mineral Hill district.—Gold Producers, Inc., operated the Grunter mine at Shoup throughout the year and treated 27,689 tons of gold ore by flotation. The rest of the district output was mainly gold ore from the Gold Hill and Meadow Mountain properties.

Parker Mountain district.—Small lots of rich gold ore were produced in 1941 from the Pinch Hit claim.

Salmon River district.—The Salmon River Dredging Co. operated its floating washer, equipped with a suction nozzle, a few months in 1941 and recovered about 50 fine ounces of gold and 8 fine ounces of silver. Other placer producers included the Bean Bar and Homestake properties.

Spring Mountain district.—A little silver-lead ore was produced in 1941 from the Galena and Red Warrior claims and copper ore from the Mountain Bell prospect.

Texas district.—The output of the Texas district in 1941 comprised 2,600 tons of gold ore (treated by cyanidation) from the Allie (Falls Creek) mine and 939 tons of crude silver-lead ore from the Latest Out property.

Yellow Jacket district.—Lessees operated the Yellow Jacket mine near Forney in 1941 and treated about 700 tons of gold ore by flotation and shipped 21 tons of rich gold ore to a smelter. The remainder of the district output was chiefly gold ore from the Bryan mine.

LEWIS COUNTY

Placer gold and silver were recovered in 1941 from gravel along the Clearwater River near Greer and Kamiah and from the Salmon River south of Forest.

NEZ PERCE COUNTY

The metal output of Nez Perce County in 1941 was principally placer gold recovered from gravel by various operators working along the Clearwater River near Myrtle and the Snake River below Lewiston.

OWYHEE COUNTY

Carson district (Silver City, De Lamar).—The principal production in the Carson district in 1941, as in 1940, was gold and silver recovered from the milling of old tailings (81,202 tons in 1941) by the De Lamar Milling Corporation. The rest of the district lode output was largely silver ore from the Henrietta and Trade Dollar mines, gold ore from the Poorman-Pauper group, and gold-silver ore from the South Central mine. Most of the placer gold and silver came from the Lewis property and from cleanings from an old dredge.

Castle Creek district.—Small lots of gold-silver ore were produced in 1941 from the Badger and Elliott claims and a little gold ore from the Buck Horn prospect.

Snake River district.—The output of placer gold in the Snake River district near Grand View was much less in 1941 than in 1940, owing to the decreased output from dredging operations. Two dry-land dredges—one operated by Cecil Rhodes and the other by F. R. Knowlton—recovered about 600 fine ounces of gold and 31 fine ounces of silver in 1941.

South Mountain district.—Continuous operation of the Golconda mine by the South Mountain Mining Co. in 1941 resulted in a marked increase in metal output from the South Mountain district; 16,663 tons of zinc ore containing gold, silver, lead, and copper were shipped to the custom flotation mill at Tooele, Utah, and 423 tons of silver-copper ore were shipped to a smelter.

Steele district.—The only output in the Steele district in 1941 was 23 tons of gold ore from the Morning Glory mine.

POWER COUNTY

The metal output of Power County in 1941 was placer gold recovered by sluicing at the Bonanza Queen and Eagle Rock properties on the Snake River near American Falls.

SHOSHONE COUNTY

COEUR D'ALENE REGION

The value of the metal output of the Coeur d'Alene region increased 10 percent in 1941 over 1940, owing chiefly to the gain in output of zinc; the output of copper also increased, but the output of gold, silver, and lead decreased. Copper increased 11 percent and zinc 9 percent; and gold decreased 50 percent, silver 6 percent, and lead less than one-half of 1 percent. The output of zinc was the largest in the history of the region and resulted chiefly from marked increases at the Star, Tamarack, Sunset, and Highland Surprise properties. More than 71 percent of the material produced in Shoshone County in 1941 was zinc-lead ore and old tailings, 22 percent silver ore, and 6 percent lead ore.

Of the total metal output in Idaho in 1941, the Coeur d'Alene region produced 88 percent of the silver, 82 percent of the copper, 91 percent of the lead, and 86 percent of the zinc.

The following table gives the production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region in 1940 and 1941 and the total for 1884 to 1941.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1940–41, and total 1884–1941, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer							
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1940	49	25	1,917,235	6,886	15,616,852	5,359,000	191,218,460	125,896,000	$29,444,265
1941	58	21	2,051,390	3,419	14,678,356	5,957,000	191,057,000	136,642,000	32,398,932
Total, 1884–1941			(1)	382,397	387,566,608	[2] 57,267	[2] 5,138,989	[2] 808,233	939,211,323

[1] Figures not available. [2] Short tons.

Beaver district.—The value of metal production in the Beaver district was $879,982 in 1941, or more than double that in 1940. Substantial increases were recorded in output of silver, copper, lead, and zinc, but the output of gold decreased. The most important producer was the Sunset mine, operated under lease; 25,416 tons of zinc-lead ore were milled in the Golconda custom flotation plant in 1941 compared with 5,603 tons in 1940; and the mine was the largest producer of silver, copper, lead, and zinc in the district. The Interstate Lease continued to operate the Interstate-Callahan property, and 16,000 tons of zinc-lead ore were treated in the Galena mill. This 200-ton mill, owned by the Callahan Zinc-Lead Co., was purchased in 1941 by Zanetti Bros., who operated the plant on custom ores and old tailings; 30,000 tons of old zinc-lead tailings were treated from the Interstate-Callahan dump, under lease to Zanetti Bros. The rest of the district lode output was mostly zinc-lead ore from the Silver Tip (Portland) and Monarch properties. The output of placer gold in the district was much less than in 1940, owing to suspension early in 1941 of dredging by the Beaver Dredging Co. Other placer producers included the Accident and Lock & Erwin claims.

Coeur d'Alene district.—About 72 tons of gold ore were produced in 1941 from the Mountain Lion mine; placer gold and silver were recovered from the Beehive Bar, Joe Gandy, and Otis properties.

Eagle district.—A lessee operating the Crystal Lead property in 1941 hauled 300 tons of lead ore to the Silver Crescent custom mill near Osburn and shipped 20 tons of similar ore to a smelter. A little placer gold was recovered from two claims on Eagle Creek.

Evolution district.—Production of silver in the Evolution district continued to decline in 1941, owing to the decrease in silver content of the Sunshine ore; the output of silver ore from the mine increased from 278,810 tons in 1940 to 305,180 tons in 1941, and the mine is still the largest producer of silver in the United States. The drop in gold output of the district resulted mainly from suspension of dredging at placer properties near Murray; and the gain in output of copper resulted from the increase in silver-copper ore from the Mineral

Point mine. The Sunshine Mining Co. reported that 7,748 tons of concentrates contained 7,138,426 ounces of silver, 2,394,641 pounds of copper, 258,855 pounds of lead, and some antimony. The milling ore treated at the Sunshine mill in 1941 contained an average of 241 ounces of silver to the ton, 0.4 percent copper, a trace of lead, and some antimony. A new plant is under construction to treat the entire production of silver-copper-antimony concentrates. Output of silver-copper ore from the Mineral Point mine of the Coeur d'Alene Mines Corporation increased from 51,209 tons in 1940 to 87,672 tons in 1941; the daily capacity of the 300-ton flotation mill was increased to 600 tons. The company reported that the concentrates contained 1,447,267 ounces of silver, 2,768,284 pounds of copper, and some antimony. The property was the largest producer of copper in Idaho and ranked third in silver output. The Polaris Mining Co. operated its mine and 200-ton mill continuously and treated 47,554 tons of silver ore, a slight decrease from 1940. The rest of the district output was principally old zinc-lead tailings from a dump near Wallace.

Hunter district (Mullan).—The output of ore and the quantity of each metal produced in the Hunter district were less in 1941 than in 1940, but the total value of the output was greater, owing to the increase in average sales price of copper, lead, and zinc. The output of recoverable zinc (64,455,400 pounds) was larger than in any district in Idaho, and the output of recoverable lead was exceeded by only one district (Yreka). Zinc-lead-silver ore from the Morning mine of the Federal Mining & Smelting Co. continued to be the chief output, but it declined from 336,603 to 270,787 tons. The average grade of the ore mined during 1941 was 3.1 ounces of silver to the ton, 7.3 percent lead, and 7.2 percent zinc. Ore reserves at the end of 1941, including developed and probable ore, are estimated at 687,000 tons. The company reported that the concentrates produced contained 207 ounces of gold, 787,009 ounces of silver, 37,232,772 pounds of lead, and 34,817,432 pounds of zinc. The property ranked second in the State in lead and zinc output and sixth in silver. The Sullivan Mining Co. operated its Star mine and 1,000-ton flotation plant throughout the year; 212,420 tons of zinc-lead ore were treated in 1941 compared with 214,464 tons in 1940. The company reported that the concentrates produced contained 209,808 ounces of silver, 14,037,830 pounds of lead, and 37,127,957 pounds of zinc. The mine was the largest producer of zinc in Idaho in 1941. Lessees continued to operate the Gold Hunter mine, and 49,942 tons of silver-lead ore were treated in the 500-ton Gold Hunter flotation plant. The rest of the district output was mainly zinc-lead ore from the Golconda mine.

Lelande district (Burke, Mace, Frisco).—The value of the metal production of the Lelande district was $4,777,186 in 1941—a gain of 14 percent over 1940; the output of each metal except zinc increased. The Hecla mine remained the most important producer in the district; 204,662 tons of zinc-lead-silver ore were treated in the company 900-ton flotation mill, and 7,282 tons of crude silver-lead ore were smelted. The company reported that the concentrates and crude ore contained 945,240 ounces of silver, 30,083,418 pounds of lead, and 17,255,660 pounds of zinc. The Sherman Lead Co. was a large producer of silver-lead ore in 1941; 52,066 tons of ore were treated in

the company 300-ton flotation plant—a marked increase over 1940. The ore treated in 1941 averaged 6.4 ounces of silver to the ton and 10.8 percent lead. The Hull Leasing Co. continued to work the Frisco mine and treated 32,000 tons of zinc-lead ore in its 100-ton flotation mill. The remainder of the district output was mostly zinc-lead ore from the Black Bear mine.

Placer Center district.—The marked increase in output of silver, lead, and zinc in the Placer Center district in 1941 resulted chiefly from the greater output of zinc-lead ore from the Tamarack mine—by far the most important producer in the district. The mine and 300-ton mill were operated continuously by the Tamarack & Custer Consolidated Mining Co.; 97,008 tons of zinc-lead ore were treated by flotation, compared with 56,121 tons in 1940. According to the printed annual report of the company, the mine is prepared for maximum production in 1942. A greater tonnage of ore is in sight now than there was in 1940; however, the grade of the ore will be lower in metal content in 1942 than in 1941, when it averaged 1.9 ounces of silver to the ton, 5.5 percent lead, and 7.3 percent zinc. A new 200-ton mill was built at the Dayrock property in 1941, and during the last quarter of the year 4,651 tons of silver-lead ore were treated by flotation; in addition, 6,630 tons of similar ore were treated in the Hercules custom mill. The ore milled averaged 7.7 ounces of silver to the ton and 8.7 percent lead. The rest of the district output was principally old zinc-lead tailings (12,665 tons) from various dumps near Wallace and zinc-lead ore from the Success mine.

St. Joe district.—Small lots of placer gold were recovered in 1941 from the Gold Producers, Grizzly, and Iron Hill claims, and a little copper ore was produced from the Hansy and Monitor properties.

Summit district (Murray).—Output of gold in the Summit district decreased sharply in 1941, owing to suspension in April of operations at the Golden Chest mine; before the mine closed, about 3,000 tons of gold ore had been concentrated. Zinc-lead ore (91 tons) was produced from the Anchor mine. Placer gold and silver were recovered by various operators working on Coeur d'Alene Mining Co. ground.

Yreka district (Kellogg).—The value ($8,711,318) of the metal output of the Yreka district in 1941 was the largest in any district of Idaho, but it exceeded that of the Hunter district by only $6,677. The production of recoverable lead was greater than in any district of the State, and that of recoverable zinc and silver ranked second. Zinc-lead ore from the Bunker Hill & Sullivan mine was again the chief output in the district; 385,060 tons were treated in the company 1,200-ton flotation plant, compared with 383,886 tons in 1940. A new 1,700-ton sink-and-float unit, added to the mill during the year, was put in operation December 1. The property remained the largest producer of lead in Idaho, second in output of silver, and third in zinc. The company reports that ore reserves on January 1, 1942, fully developed and ready to mine, totaled 2,730,398 tons of zinc-lead-silver ore. The Federal Mining & Smelting Co. operated the Blackhawk and Page mines and the Page 500-ton mill throughout the year; 102,352 tons of zinc-lead ore from the Page mine and 11,854 tons of similar ore from the Blackhawk were treated. The Highland Surprise property was reopened early in the year, after being idle since April 1927, and 21,000 tons of zinc-lead ore were treated in the company 100-ton flotation mill. The old Constitution (Spokane-Idaho) mine

also was reopened, and 6,973 tons of zinc-lead ore were treated by flotation. About 10,000 tons of silver ore from the Crescent group were concentrated, and 1,536 tons of similar ore were shipped to a smelter. The rest of the district output was largely zinc-lead ore from the Little Pittsburg, Liberal King, and Nabob properties.

TWIN FALLS COUNTY

The metal output of Twin Falls County in 1941 was, as usual, placer gold and silver recovered by sluicing at various properties along the Snake River.

VALLEY COUNTY

Big Creek district.—Nearly all the output of the Big Creek district in 1941 was gold ore concentrated from the Sunday mine.

Deadwood Basin district.—A little placer gold recovered from claims on Bummer Creek and Deadwood Creek was the only output in the Deadwood Basin district in 1941.

Lake City (McCall) district.—Hydraulicking and sluicing in 1941 at the Neely Hill and Boulder Creek properties recovered a little placer gold and silver.

Pistol Creek district.—Gold-lead ore from the Lucky Boy mine continued to be the only output in the Pistol Creek district.

Thunder Mountain district.—A substantial increase was made in output of gold in the Thunder Mountain district in 1941, owing to operation of the Sunnyside mine and mill by the Gold Reef Mining Co.; 9,300 tons of gold ore were treated by amalgamation. Placer gold and silver were recovered chiefly from the Dewey claim.

Yellow Pine district.—The Bradley Mining Co. operated the Yellow Pine property throughout 1941. However, the output of antimony-gold ore declined from 132,297 tons in 1940 to 80,658 tons in 1941, resulting in a substantial decrease in gold output for district. In August the 400-ton gold mill was converted into a 200-ton mill.

WASHINGTON COUNTY

Nearly all the output in Washington County in 1941 was silver-copper ore from the Silver Still mine and gold-copper ore from the Condor property, both in the Washington (Mineral Creek) district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

SUMMARY

The Montana output of gold, silver, copper, lead, and zinc had a greater aggregate value in 1941 than in 1940, but only the quantity of copper, silver, and zinc increased. The total value of the five metals was $59,181,627 compared with $55,825,078 in 1940 (see fig. 1). The gold output from several of the larger lode gold mines throughout the State dropped sharply; the output from placer mines was slightly less than in 1940. The decline in lead output in 1941 was due in part to a general decline in production at several large lead-producing mines and in part to suspension of operations at the Comet mine in Jefferson County after 3 months of operation. The value of the metal output from Silver Bow County—by far the most productive area in the State and from which virtually all the copper and much of the zinc and silver are derived—was $44,195,725 in 1941 compared with $40,871,719 in 1940. This increase was due to near-capacity operations of the Anaconda Copper Mining Co.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35 00	$0 7735	$0 121	$0 059	$0.065
1938	35 00	[4] 646+	.098	046	.048
1939	35 00	[5] 678+	.104	.047	.052
1940	35 00	[6] 711+	.113	050	.063
1941	35 00	[6] .711+	.118	057	075

[1] Price under authority of Gold Reserve Act of January 31, 1934 Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20 67+ ($20 671835) per fine ounce

[2] 1937: Yearly average weighted Treasury buying price for newly mined silver, 1938–41. Treasury buying price for newly mined silver

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464. [5] $0 67878787. [6] $0 71111111.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1937–41, and total, 1862–1941, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	615	406	4,898,009	202,252	$7,078,820	11,812,093	$9,136,654
1938	482	265	2,724,466	203,313	7,115,955	6,403,962	4,139,935
1939	594	282	3,792,780	264,173	9,246,055	9,087,571	6,168,533
1940	687	285	5,099,241	272,602	9,541,070	12,361,050	8,790,080
1941	612	325	5,642,249	246,475	8,626,625	12,386,925	8,808,480
1862–1941			(1)	16,680,518	368,271,342	713,202,910	521,196,672

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	289,056,000	$34,975,776	35,914,000	$2,118,926	78,336,000	$5,091,840	$58,402,016
1938	154,426,000	15,133,748	18,654,000	858,084	17,688,000	849,024	28,096,746
1939	195,654,000	20,348,016	33,110,000	1,556,170	69,598,000	3,619,096	40,937,870
1940	252,782,000	28,564,366	46,072,000	2,303,600	105,174,000	6,625,962	55,825,078
1941	256,072,000	30,216,496	42,518,000	2,423,526	121,420,000	9,106,500	59,181,627
1862–1941	[2] 6,037,457	1,757,899,462	[2] 627,242	66,507,668	[2] 1,699,667	254,791,430	2,968,666,574

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Montana, 1937–41, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges: Dry-land [1]		Dredges: Dragline floating [1]		Dredges: Floating bucket		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1937	[2] 2,989	[2] 369	(2)	(2)	11,355	2,919	4,489	1,330	17,564	1,797	36,397	6,415
1938	[2] 3,896	[2] 351	(2)	(2)	5,721	1,533	4,375	1,410	21,356	3,240	35,348	6,534
1939	2,075	232	208	20	9,164	2,722	9,737	1,937	33,815	6,723	54,999	11,634
1940	2,163	272	281	41	11,252	2,640	11,439	1,302	39,012	7,400	64,147	11,655
1941	2,305	353	139	17	14,663	2,408	10,660	833	33,844	6,424	61,611	10,035

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Figures for sluicing and hydraulic include those for drift mining.

Gold.—Montana ores and gravels yielded 246,475 fine ounces of gold in 1941 compared with 272,602 ounces in 1940—a 10-percent decrease. In 1941 the output from lode mines decreased 23,591 ounces and that from placer mines 2,536 ounces. Siliceous ores yielded 64 percent of the State total and base metal-ores 11 percent; there was a decrease from siliceous ores but an increase from copper, lead, and zinc-lead ores. Gains were noted in output of recovered gold from Park, Silver Bow, Broadwater, Ravalli, and Cascade Counties but losses from Lewis and Clark, Madison, Jefferson, Powell, and Phillips Counties Gold ore mined in 1941 totaled 695,481 tons compared with 803,173 tons in 1940 and included 542,870 tons treated in amalgamation and cyanidation mills, 99,293 tons in concentrating mills, and 53,318 tons shipped crude to smelters. Ore treated at

amalgamation and cyanidation plants (with or without concentrating equipment) yielded 29 percent of the State total gold, that at concentrating mills 22 percent, ores of all classes shipped crude to smelters 24 percent, and placers 25 percent.

The leading gold producer in Montana was again the West Mayflower property in Madison County, operated by the Anaconda Copper Mining Co.; it was followed by all company-operated copper mines at Butte, the Ohio Keating mine in Broadwater County, the

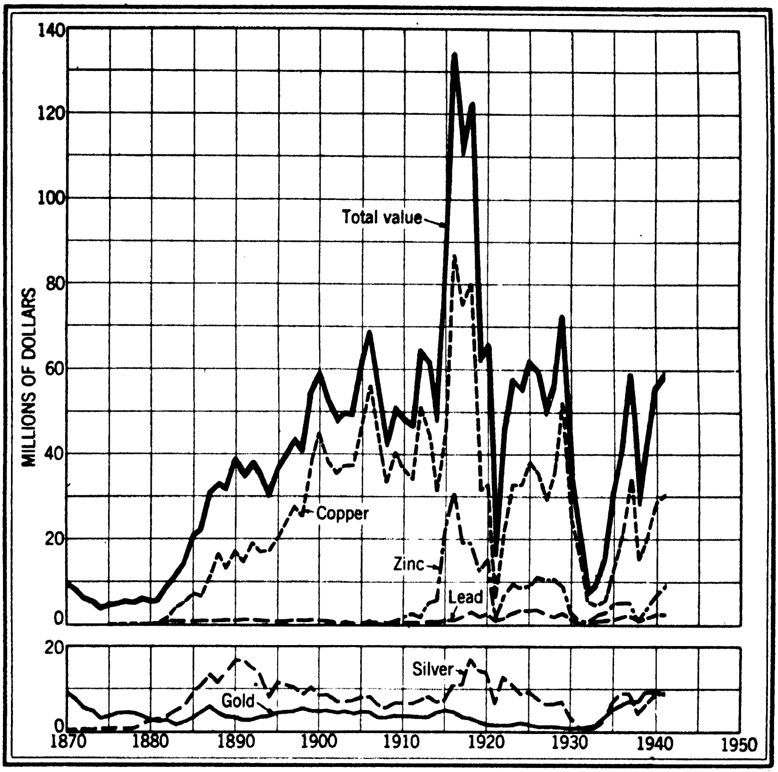

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870–1941.

Winston dredge operating on Prickly Pear Creek near Clancey, the Ruby Gulch mine at Zortman, and Porter Bros. dredge near Helena.

Silver.—The output of recoverable silver in Montana in 1941 was 12,386,925 fine ounces, virtually the same as in 1940. Copper ore yielded 50 percent of the State total silver, zinc-lead ore 24 percent, and siliceous ore 24 percent. Ore treated at concentration mills yielded 82 percent of the total silver and crude smelting ore 17 percent. The output of silver ore was 122,684 tons and of gold-silver ore 121,902 tons.

The copper mines, dumps, and zinc mines at Butte and the Flathead mine in Flathead County, all operated by the Anaconda Copper Mining Co., produced 73 percent of the State silver. Other large producers included the Lexington group in the Montana district,

Cascade County; the Granite-Bimetallic mine (tailings) in Granite County; the Emma mine at Butte (including byproduct silver); and the Florence mine in Cascade County.

Copper.—Copper produced in Montana in 1941, in terms of recoverable metal, showed a gain of 3,290,000 pounds in quantity and $1,652,130 in value over 1940. Copper ore and precipitates yielded recoverable gold, silver, copper, and lead valued at $34,296,577 or 58 percent of the value of the State output. The Anaconda Copper Mining Co. was, as usual, the only important copper producer in Montana; although the output of copper from all sources of company operations in the Butte district showed a net gain, the output of copper from company mines, precipitates, and old mine dumps showed a decrease from 1940 which was more than offset by the copper recovered from the milling of old works tailings. In 1941 the company shipped 2,869,051 tons of copper ore to the mills compared with 2,737,572 tons in 1940, 405,862 tons of mine-dump material compared with 510,972 tons in 1940, and 512,930 tons of old tailings compared with none in 1940. In addition, 36,596 tons of crude ore and 32,881 tons of old tailings were shipped direct to the smelter.

Lead and zinc.—The value of the output of lead and zinc in Montana, in terms of recoverable metals, showed increases in 1941 over 1940; however, the increase in total value of the lead was due to the higher average price for the metal, inasmuch as the quantity decreased. Zinc showed a 37-percent increase in value and a 15-percent gain in quantity; lead a 5-percent increase in value but an 8-percent decrease in quantity. All zinc mines, plus the Anaconda slag-fuming plant at East Helena, showed a gain over 1940 of 14,091,956 pounds in recovered zinc but a loss of 104,154 pounds in lead. The Emma mine, operated under lease by the Anaconda Copper Mining Co., reported a decrease of about 6,500,000 pounds in recovered zinc and 1,300,000 pounds in lead from zinc-lead ore. However, it showed a gain of about 5,500,000 pounds in zinc and 1,400,000 pounds in lead as a byproduct. In 1941 the Jack Waite mine in Sanders County made an increased output of zinc, but its production of lead decreased. The Flathead mine in Flathead County, operated by the Anaconda Copper Mining Co., reported a decreased output of lead. The Comet mine in Jefferson County showed a decrease in output of both metals, as operations were suspended in April 1941. The leading sources of zinc production in Montana in 1941 were the zinc mines of the Anaconda Copper Mining Co. at Butte, the fuming plant at East Helena, the Emma mine, the Emma byproduct zinc production, the Broadwater group in Cascade County, the Poulin mine in Silver Bow County, the Jack Waite mine in Sanders County, and the Mike Horse mine in Lewis and Clark County; these sources supplied 98 percent of the State total. The leading lead producers in Montana in 1941 were the zinc mines at Butte, the Jack Waite mine, the Flathead mine in Flathead County, the slag-fuming plant at East Helena, the Emma mine, the Broadwater mine, the Mike Horse mine, and the Emma byproduct lead output; these sources were credited with 84 percent of the State total.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead	46	17	10,958	$383,530	120,375	$85,600
Broadwater	53	33	29,596	1,035,860	47,752	33,957
Cascade	10		4,839	169,365	1,104,047	785,100
Deer Lodge	13	6	4,135	144,725	22,123	15,732
Fergus	6	1	2,760	96,600	1,291	918
Flathead	3		303	10,605	665,138	472,987
Gallatin		1	9	315		
Granite	56	17	13,906	486,710	526,798	374,612
Jefferson	84	23	21,709	759,815	233,733	166,210
Judith Basin	5		116	4,060	2,714	1,930
Lewis and Clark	64	49	33,419	1,169,665	145,838	103,707
Lincoln	7	7	2,357	82,495	10,274	7,306
Madison	166	37	53,956	1,888,460	233,394	165,969
Meagher	1	18	228	7,980	66	47
Mineral		25	1,231	43,085	59	42
Missoula	8	26	3,513	122,955	360	256
Park	4	8	16,143	565,005	64,291	45,718
Phillips	2	2	11,602	406,070	106,169	75,498
Powell	25	34	3,500	122,500	55,485	39,456
Ravalli	2	2	2,445	85,575	19,793	14,075
Sanders	6	2	237	8,295	33,532	23,845
Silver Bow	50	15	29,485	1,031,975	8,993,693	6,395,515
Stillwater		1	22	770		
Sweet Grass	1		1	35		
Toole		1	5	175		
	612	325	246,475	8,626,625	12,386,925	8,808,480
Total, 1940	687	285	272,602	9,541,070	12,361,050	8,790,080

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	63,000	$7,434	507,000	$28,899	2,000	$150	$505,613
Broadwater	26,500	3,127	634,000	36,138			1,109,082
Cascade	46,000	5,428	3,201,000	182,457	2,948,000	221,100	1,363,450
Deer Lodge	58,500	6,903					167,360
Fergus	150	18					97,536
Flathead	59,000	6,962	5,647,000	321,879			812,433
Gallatin							315
Granite	336,500	39,707	955,000	54,435	748,000	56,100	1,011,564
Jefferson	125,000	14,750	1,115,700	63,595	215,600	16,170	1,020,540
Judith Basin	14,900	1,758	43,400	2,474			10,222
Lewis and Clark	137,000	16,166	5,257,000	299,649	38,598,000	2,894,850	4,484,037
Lincoln	1,450	171	256,000	14,592	26,400	1,980	106,544
Madison	108,000	12,744	557,000	31,749			2,098,922
Meagher	400	47					8,074
Mineral							43,127
Missoula	1,100	130	300	17			123,35[illegible]
Park	105,500	12,449	288,300	16,433	160,000	12,000	651,605
Phillips							481,568
Powell	7,000	826	153,400	8,744	44,000	3,300	174,826
Ravalli	8,000	944	52,400	2,987	442,600	33,195	136,776
Sanders	111,000	13,098	6,589,600	375,607	2,095,000	157,125	577,970
Silver Bow	254,863,000	30,073,834	17,260,900	983,871	76,140,400	5,710,530	41,195,725
Stillwater							770
Sweet Grass							35
Toole							175
	256,072,000	30,216,496	42,518,000	2,423,526	121,420,000	9,106,500	59,181,627
Total, 1940	252,782,000	28,564,366	46,072,000	2,303,600	105,174,000	6,625,962	55,825,078

Gold and silver produced at lode mines in Montana in 1941, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Beaverhead	43,986	7,120	120,060	Meagher	5	4	21
Broadwater	64,400	20,129	46,800	Missoula	190	396	308
Cascade	103,288	4,839	1,104,047	Park	91,147	13,952	63,983
Deer Lodge	19,470	4,126	22,123	Phillips	119,115	11,596	106,169
Fergus	75,661	2,732	1,246	Powell	5,711	2,855	55,374
Flathead	32,552	303	665,138	Ravalli	12,132	206	19,672
Granite	88,265	8,219	526,303	Sanders	29,889	206	33,525
Jefferson	53,954	8,198	228,721	Silver Bow	4,421,641	29,463	8,993,693
Judith Basin	300	116	2,714	Sweet Grass	1	1	
Lewis and Clark	330,442	18,491	144,128				
Lincoln	27,015	2,305	10,267		5,642,249	184,864	12,376,890
Madison	123,085	49,607	232,598	Total, 1940	5,099,241	208,455	12,349,395

Gold and silver produced at placer mines in Montana in 1941, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating [1]		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead	66	3	4		941	125	2,827	187			3,838	315
Broadwater	76	10	15	1	3,955	435	5,421	506			9,467	952
Deer Lodge	9										9	
Fergus	28	45									28	45
Gallatin	9										9	
Granite	101	10	14	1	441	34			5,131	450	5,687	495
Jefferson	151	45	3		3,464	1,298			9,893	3,669	13,511	5,012
Lewis and Clark	199	25	22	2	1,288	319			13,419	1,364	14,928	1,710
Lincoln	52	7									52	7
Madison	548	86	16	1	510	64			3,275	645	4,349	796
Meagher	50	5			117	27	57	13			224	45
Mineral	106	5	10		1,115	54					1,231	59
Missoula	264	4			2,735	42	118	6			3,117	52
Park	10		55	12					2,126	296	2,191	308
Phillips	6										6	
Powell	570	101			75	10					645	111
Ravalli	2						2,237	121			2,239	121
Sanders	31	7									31	7
Silver Bow	22										22	
Stillwater					22						22	
Toole	5										5	
	2,305	353	139	17	14,663	2,408	10,660	833	33,844	6,424	61,611	10,035
Total, 1940	2,163	272	281	41	11,252	2,640	11,439	1,302	39,012	7,400	64,147	11,655

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

Continuous operation of the zinc mines, the copper mines, and the Emma mine at Butte by the Anaconda Copper Mining Co. and increased production of zinc-lead ore from mines in Cascade, Lewis and Clark, and Granite Counties in 1941 maintained the output of copper, silver, and lead at substantially the same level as in 1940 and helped to increase the yield of zinc considerably above that in 1940. The chief gain in zinc output came from the slag-fuming plant at East Helena. Metals from ore treated at cyanidation and amalgamation mills and crude ore shipped to smelters showed a decline in 1941.

Declines of 2,536 fine ounces in gold and 1,620 fine ounces in silver were noted in the yield from placer mines. Seven connected-bucket floating dredges were in operation in 1941; they treated 9,025,755 cubic yards of gravel and recovered gold valued at $1,184,540, indicating an average recoverable gold value of 13.1 cents per cubic yard treated. Dragline and power shovels with both dry-land and floating washing plants were reported in operation at 40 properties. The plants washed 3,208,961 cubic yards of gravel and recovered gold valued at $886,305, indicating an average recoverable gold value of 27.6 cents to the cubic yard washed.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Montana in 1941, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	343	695, 481	140, 138	390, 639	243, 465	231, 558	-
Dry and siliceous gold-silver ore	76	121, 902	11, 277	700, 663	1, 608, 067	542, 782	-
Dry and siliceous silver ore	69	122, 684	5, 170	1, 823, 971	1, 093, 608	654, 962	-
	[1] 484	940, 067	156, 585	2, 915, 273	2, 945, 140	1, 429, 302	-
Copper ore	19	3, 791, 202	13 871	6, 142, 250	[2] 249,518, 972	547	-
Lead ore	103	33, 029	5, 007	309, 341	37, 848	9, 701, 161	-
Lead-copper ore	1	4	-	136	562	750	-
Zinc ore	2	[3] 182, 745	138	20, 481	8, 579	3, 107, 046	37, 960, 400
Zinc-lead ore	23	695, 202	9, 263	2, 989, 409	3, 560, 899	28, 279, 194	83, 459, 600
Total, lode mines	[1] 612	5, 642, 249	184, 864	12, 376, 890	[2] 256,072, 000	42, 518, 000	121, 420, 000
Total, placers	325	-	61, 611	10, 035	-	-	-
	937	5, 642, 249	246, 475	12, 386, 925	[2] 256,072, 000	42, 518, 000	121, 420, 000
Total, 1940	972	5, 099, 241	272, 602	12, 361, 050	[4] 252,782, 000	46, 072, 000	105, 174, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 5,503,585 pounds recovered from precipitates
[3] Includes 170,592 tons of current slag fumed.
[4] Includes 5,624,886 pounds recovered from precipitates.

METALLURGIC INDUSTRY

The 5,642,249 tons of ore produced from Montana lode mines in 1941 were treated as follows: 99,482 tons at amalgamation plants, 443,388 tons at cyanidation mills, 4,661,117 tons at concentration mills, 267,670 tons shipped crude to smelters, and 170,592 tons treated at a slag-fuming plant.

Nine cyanidation mills treated 351,663 tons of gold ore, which contained 51,517 ounces of gold and 213,783 ounces of silver; the bullion and precipitates shipped contained 42,946 fine ounces of gold and 137,301 fine ounces of silver, indicating an average recovery of 83 percent of the gold and 64 percent of the silver. Nine mills treating 351,663 tons of gold ore reported the consumption of 190,718 pounds of sodium cyanide, 321,646 pounds of calcium cyanide, 55,087 pounds of zinc dust, and 2,839,780 pounds of lime

Ore treated at straight concentration plants increased from 4,101,902 tons in 1940 to 4,661,117 tons in 1941. The 1941 total comprised 155,034 tons of siliceous ores, 3,790,183 tons of copper ore, 8,545 tons of lead ore, 12,153 tons of zinc ore, and 695,202 tons of zinc-lead ore.

The East Helena smelter continued to operate throughout 1941 and treated ores and concentrates, chiefly from Montana and Idaho. The Anaconda electrolytic zinc plants, with four units at Anaconda and eight units at Great Falls, operated at an average capacity of about 2,575,000 pounds of zinc per unit per month, in terms of slab zinc, zinc dross, and zinc oxide. This rate was a 22-percent increase over that in 1940. Capacity at the plants in 1942 has been increased by adding additional tanks, and work is now under way to add the equivalent of one new unit at Anaconda and two units at Great Falls, which will increase the annual capacity of these plants to 465,000,000 pounds before the end of 1942.

Details of the treatment of all ores produced in Montana in 1941 are given in the tables that follow.

Mine production of metals in Montana in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	99,482	7,938	2,508			
Ore cyanided	443,388	56,293	166,587			
Concentrates smelted [1]	662,594	60,046	10,102,389	247,705,376	29,513,047	83,918,000
Copper precipitates smelted	4,501			5,503,585		
Ore smelted	267,670	60,587	2,105,406	2,863,039	9,950,953	
Slag fumed	170,592				3,054,000	37,502,000
Placer		61,611	10,035			
		246,475	12,386,925	256,072,000	42,518,000	121,420,000
Total, 1940		272,602	12,361,050	252,782,000	46,072,000	105,174,000

[1] Includes zinc concentrates treated at electrolytic plants.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1941, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Beaverhead	50	23	2					
Broadwater	622	674	276					
Deer Lodge	150	11						
Granite	228	49	6	4	55	26		
Jefferson	422	351	51	12	29	144	167	970
Lewis and Clark	1,309	230	631	3	6	8		
Lincoln	19,289	1,379	348	253	645	1,112	849	20,999
Madison	7,954	573	161	255	996	2,219	8,764	
Park	69,324	4,540	1,028	1,673	2,746	650	1,400	
Powell	2	38	5					
Ravalli	132	70						
	99,482	7,938	2,508	2,200	4,477	4,159	11,180	21,969
Total, 1940	89,361	9,664	2,178	2,919	5,216	13,252	9,456	100,490

CYANIDATION MILLS

County	Ore treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Beaverhead	31,855	4,939	576					
Deer Lodge	17,180	3,901	567					
Fergus	75,646	2,728	1,109					
Granite	780	225	9	4	9	9		
Lewis and Clark	124,221	15,743	52,764					
Madison	56,276	10,888	5,345	139	1,879	806	1,156	22,550
Phillips	119,091	11,552	105,703					
Silver Bow	18,339	6,317	514					
	443,388	56,293	166,587	143	1,888	815	1,156	22,550
Total, 1940	466,024	72,874	180,559	104	245	643	211	7,004
Grand total, 1941	542,870	64,231	169,095	2,343	6,365	4,974	12,336	44,519
1940	555,385	82,538	182,737	3,023	5,461	13,895	9,667	107,494

Mine production of metals from concentrating mills in Montana in 1941, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	766	213	113	1,352	922	67,341	2,000
Broadwater	59,705	9,695	15,150	2,098			
Cascade	103,057	7,340	4,530	1,065,125	44,028	3,180,125	2,948,000
Deer Lodge	200	47	18	208			
Granite	19,437	1,574	23	47,097	32,555	709,506	748,000
Jefferson	39,555	3,698	1,429	136,455	78,948	842,454	215,600
Lewis and Clark	30,574	3,077	399	76,060	129,330	1,985,319	1,096,000
Lincoln	7,643	335	267	8,580	601	228,114	26,400
Madison	18,963	1,406	3,746	7,254	77,966	1,433	
Park	21,500	1,082	6,512	47,862	103,998	214,914	160,000
Powell	445	187	134	4,186	3,447	52,382	44,000
Ravalli	12,000	515	136	19,672	8,000	52,400	442,600
Sanders	28,382	5,424	125	25,213	76,113	4,884,057	2,095,000
Silver Bow	4,318,890	625,658	21,099	8,656,253	247,137,132	17,250,483	76,140,400
	4,661,117	660,251	53,681	10,097,415	247,693,040	29,468,528	83,918,000
Total, 1940	4,101,902	659,809	49,135	9,797,041	243,758,594	30,545,854	76,011,400

Gross metal content of concentrates produced from ore mined in Montana in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	12, 212	21, 893	9, 061	13, 400	51, 762	
Dry gold-silver	3	4	332		101	
Dry silver	1, 403	3, 064	547, 185	31, 158	124, 422	
Copper	511, 451	23, 919	6, 157, 633	248, 692, 523	3, 444	
Lead	19, 537	3, 417	1, 113, 575	1, 376, 762	22, 110, 719	1, 777, 987
Lead-copper	144	30	3, 472	12, 772	76, 997	
Zinc	89, 757	5, 424	2, 007, 541	2, 131, 988	8, 773, 992	93, 222, 377
Zinc-lead	28		1, 166	83	3, 474	19, 960
Dry iron (from zinc-lead ore)	28, 059	2, 295	262, 424	393, 418	903, 041	2, 372, 104
	662, 594	60, 046	10, 102, 389	252, 652, 104	32, 047, 952	97, 392, 428
Total, 1940	662, 832	54, 596	9, 810, 936	250, 131, 853	32, 595, 168	88, 251, 640

Mine production of metals from Montana concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	213	113	1, 352	922	67, 341	2, 000
Broadwater	9, 695	15, 150	2, 098			
Cascade	7, 340	4, 530	1, 065, 125	44, 028	3, 180, 125	2, 948, 000
Deer Lodge	47	18	208			
Granite	1, 582	87	47, 132	32, 555	709, 506	748, 000
Jefferson	3, 710	1, 458	136, 599	79, 115	843, 424	215, 600
Lewis and Clark	3, 080	405	76, 068	129, 330	1, 985, 319	1, 096, 000
Lincoln	588	912	9, 692	1, 450	249, 113	26, 400
Madison	1, 800	6, 621	10, 279	87, 886	23, 983	
Park	2, 755	9, 258	48, 512	105, 398	214, 914	160, 000
Powell	187	134	4, 186	3, 447	52, 382	44, 000
Ravalli	515	136	19, 672	8, 000	52, 400	442, 600
Sanders	5, 424	125	25, 213	76, 113	4, 884, 057	2, 095, 000
Silver Bow	625, 658	21 099	8, 656, 253	247, 137, 132	17, 250, 483	76, 140, 400
	662 594	60, 046	10, 102, 389	247, 705, 376	29, 513, 047	83, 918, 000
Total, 1940	662, 832	54, 596	9, 810, 936	243, 768, 261	30, 653, 348	76, 011, 400

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	12, 212	21, 893	9, 061	12, 489	49, 662	
Dry gold-silver	3	4	332		97	
Dry silver	1, 403	3, 064	547, 185	26, 484	119, 445	
Copper	511, 451	23, 919	6, 157, 633	244, 078, 680	3, 306	
Lead	19, 537	3, 417	1, 113, 575	1, 170, 127	21, 227 112	
Lead-copper	144	30	3, 472	11, 150	73, 963	
Zinc	89, 757	5, 424	2, 007, 541	2, 025, 479	7, 984, 257	83, 900, 000
Zinc-lead	28		1, 166	79	3, 161	18, 000
Dry iron (from zinc-lead ore)	28, 059	2, 295	262, 424	380, 888	52, 044	
	662, 594	60, 046	10, 102, 389	247, 705, 376	29, 513, 047	83, 918, 000

Gross metal content of Montana crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	53,318	43,911	200,917	54,890	188,546	----------
Dry and siliceous gold-silver	114,043	10,838	683,794	1,779,426	644,463	----------
Dry and siliceous silver	74,802	1,067	946,610	1,107,996	38,686	----------
Copper	1,019	61	5,308	126,217	570	----------
Lead	24,484	4,710	268,641	43,387	9,697,598	----------
Lead-copper	4	---	136	661	781	----------
	267,670	60,587	2,105,406	3,112,577	10,570,644	----------
Total, 1940	278,031	71,321	2,355,722	3,481,623	14,247,622	261,690

Mine production of metals from Montana crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	11,315	2,045	118,130	62,078	439,659	----------
Broadwater	4,073	4,305	44,426	26,500	631,000	----------
Cascade	231	309	38,922	1,972	20,875	----------
Deer Lodge	1,940	196	21,348	58,500	----	----------
Fergus	15	4	137	150	-----	----------
Flathead	32,552	303	665,138	59,000	5,647,000	----------
Granite	67,820	7,858	479,156	303,945	245,494	----------
Jefferson	13,977	6,389	92,071	45,885	272,276	----------
Judith Basin	300	116	2,714	14,900	43,400	----------
Lewis and Clark	3,746	2,113	14,665	7,670	217,681	----------
Lincoln	83	14	227	----------	6,887	----------
Madison	39,892	31,525	216,813	20,114	533,017	----------
Meagher	5	4	21	400	-----	----------
Missoula	190	396	308	1,100	300	----------
Park	323	154	14,443	102	73,386	----------
Phillips	24	44	466	----------	----------	----------
Powell	5,264	2,683	51,183	3,553	101,018	----------
Sanders	1,507	81	8,312	34,887	1,705,543	----------
Silver Bow	84,412	2,047	336,926	2,222,283	10,417	----------
Sweet Grass	1	1	----------	----------	-------	----------
	267,670	60,587	2,105,406	2,863,039	9,950,953	---
Total, 1940	278,031	71,321	2,355,722	3,388,853	12,692,652	238,600

BY CLASSES OF ORE

Dry and siliceous gold	53,318	43,911	200,917	49,641	177,123	----------
Dry and siliceous gold-silver	114,043	10,838	683,794	1,599,611	427,400	----------
Dry and siliceous silver	74,802	1,067	946,610	1,054,930	36,355	----------
Copper	1,019	61	5,308	121,882	547	----------
Lead	24,484	4,710	268,641	36,413	9,308,778	----------
Lead-copper	4		136	562	750	----------
	267,670	60,587	2,105,406	2,863,039	9,950,953	----------

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Montana in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Beaverhead County:													
Argenta	24	2	35,770	6,384	9	6,393	15,366		15,366	1,600	228,000		$247,867
Bald Mountain	1		3				90		90				64
Bannack	4	11	230	191	2,951	3,142	353	201	554	1,100	200		110,505
Big Hole	3	1	242	113	1	114	263		263		32,300		6,018
Blue Wing	7		273	16		16	5,895		5,895	2,000	9,300	2,000	5,668
Bryant	3		4,546	390		390	40,545		40,545	58,300	183,400		59,815
Colorado	1		92	6		6	533		533		52,400		3,576
Horse Prairie Creek		2			849	849		114	114				29,796
Vipond	3		2,830	20		20	57,015		57,015		1,400		41,324
West Fork Madison River		1			28	28							980
Broadwater County:													
Backer	4	17	332	596	876	1,472	488	149	637	1,100	400		52,126
Beaver	17		2,957	2,859		2,859	34,117		34,117	14,000	465,400		152,506
Cedar Plains	13	2	59,861	15,301	6	15,307	3,524		3,524	10,100	22,600		540,731
Park	19	14	1,250	1,373	8,585	9,958	8,671	803	9,474	1,300	145,600		363,719
Cascade County: Montana	10		103,288	4,839		4,839	1,104,047		1,104,047	46,000	3,201,000	2,948,000	1,363,450
Deer Lodge County:													
Dry Gulch		2			3	3							105
French Gulch		1			1	1							35
Georgetown	7	1	17,487	4,042	2	4,044	782		782	550			142,161
Heber	1	1	200	18	2	20	208		208				848
Lost Creek		1			1	1							35
Oro Fino	2		1,176	55		55	17,564		17,564				14,415
Silver Lake	2		19	1		1	104		101	1,100			239
Smelter	1		588	10		10	3,465		3,465	56,850			9,522
Fergus County:													
Cone Butte	2		114	15		15	31		31				547
North Moccasin	1	1	75,535	2,715	28	2,743	1,080	45	1,125				96,805
Warm Springs	3		12	2		2	135		135	150			184
Flathead County: Hog Heaven	3		32,552	303		303	665,138		665,138	59,000	5,647,000		812,433
Gallatin County: Eldridge		1			9	9							315
Granite County:													
Alps	2		12	1		1	45		45				67
Boulder	10	2	1,251	456	15	471	3,375		3,375	1,100	14,400	15,800	21,021
Dunkleberg	2		18,815	20		20	37,509		37,509	30,400	702,600	644,600	119,353
First Chance	19	9	2,918	2,237	5,287	7,524	2,143	464	2,607	2,000			265,430
Flint Creek	13		64,324	5,207		5,207	480,375		480,375	301,600	228,000	87,600	579,000
Gold Creek		3			49	49		7	7				1,720

Henderson	3	1	204	18	328	346	2,624	24	2,648	1,400			14,158
Mayville	2		19	4		4	163		163		10,000		826
Red Lion	3		191	95		95	7		7				3,330
Rock Creek	2	2	531	181	8	189	62		62				6,659
Jefferson County:													
Amazon	2		85	22		22	1,291		1,291	600	13,300		2,517
Bigfoot	1		33	5		5	38		38				202
Boulder	6	2	424	39	10	49	3,839		3,839	400	10,900		5,113
Cataract	23	5	12,830	1,877	24	1,901	133,920	7	133,927	74,800	709,800	186,000	225,007
Clancey	4	13	142	14	12,402	12,416	429	4,417	4,846	200	1,800		438,133
Colorado	13		32,721	1,424		1,424	78,719		78,719	40,800	284,600	29,600	129,074
Elkhorn	4		132	153		153	211		211		1,600		5,596
Golconda	4		60	58		58	284		284		2,000		2,346
Homestake	7	1	83	51	4	55	488		488				2,272
Lowland	2	2	237	4	1,071	1,075	69	588	657	500			38,151
Mitchell	5		82	82		82	187		187	100	400		3,038
Warm Springs	1		61	16		16	284		284		1,000		819
Whitehall	11		6,764	3,707		3,707	8,131		8,131	5,000	78,000		140,563
Willow Creek	1		300	746		746	831		831	2,600	12,300		27,709
Judith Basin County													
Barker	3		93	2		2	1,845		1,845	50	43,400		3,862
Yogo	2		207	114		114	869		869	14,850			6,360
Lewis and Clark County													
Blue Cloud	1		24				225		225		7,300		576
Dry Gulch	1	1	50,000	7,307	1	7,308	6,030		6,030				260,068
Greenhorn		2			4	4							140
Heddleston	4		28,510	78		78	65,482		65,482	123,700	1,933,000	1,096,000	256,273
Helena	14	24	508	348	8,403	8,751	322	772	1,094	900	2,100		307,289
Jefferson Gulch		1			19	19							665
Lincoln	3	8	17	13	99	112	38	14	52				3,957
Marysville	19	6	49,780	5,320	1,198	6,518	31,192	263	31,455	3,100	64,100		254,518
Missouri		2			5,088	5,088		602	602				178,508
Ophir Gulch	1		67	45		45	21		21	2,300			1,861
Rimini	6	2	1,106	185	103	288	9,370	59	9,429	3,000	189,600		27,946
Scratch Gravel	3		115	36		36	135		135	100	3,300		1,556
Silver City	1		900	74		74	547		547				2,979
Smelter	1		170,592								3,054,000	37,502,000	2,986,728
Stemple	10	3	28,823	5,085	13	5,098	30,766		30,766	3,900	3,600		200,973
Lincoln County: Libby	7	7	27,015	2,305	52	2,357	10,267	7	10,274	1,450	256,000	26,400	106,544
Madison County													
Cherry Creek (Havana)	1		1				14		14				10
Norris	23	3	18,880	10,575	1,500	12,075	11,219	194	11,413	2,600	31,700		432,855
Pony	21	1	18,240	3,941	4	3,945	6,210		6,210	78,300	600		151,764
Renova	9	1	20,329	20,342	1	20,343	136,485		136,485	5,400	50,300		812,565
Rochester	12		873	331		331	3,915		3,915	200	63,300		18,001
Ruby Creek		1			49	49		14	14				1,725
Sheridan	30	8	2,935	1,260	123	1,383	10,409	14	10,423	2,400	373,000		77,361
Silver Star	14		47,827	8,152		8,152	11,115		11,115	16,900	4,100		295,452
Tidal Wave	18		1,364	1,073		1,073	4,022		4,022	1,700	28,000		42,212
Virginia City	34	21	12,293	3,711	883	4,594	48,354	121	48,475	400	2,000		195,422
Washington	4	2	343	222	1,789	2,011	855	453	1,308	100	4,000		71,555

Mine production of gold, silver, copper, lead, and zinc in Montana in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Meagher County													
Beaver Creek		17			215	215		45	45				$7,557
Camas Creek		1			9	9							315
Carbonate	1		5	4		4	21		21	400			202
Mineral County: Cedar Creek		25			1,231	1,231		59	59				43,127
Missoula County													
Coloma	7		175	394		394	308		308	600	300		14,097
Copper Cliff	1		15	2		2				500			129
Elk Creek		2			4	4							140
Nine Mile		24			3,113	3,113		52	52				108,992
Park County													
Cowles		1			2	2							70
Emigrant Creek		6			2,188	2,188		308	308				76,799
New World	3	1	21,678	6,516	1	6,517	62,294		62,294	104,100	288,300	160,000	313,110
Sheepeater (Jardine)	1		69,469	7,436		7,436	1,689		1,689	1,400			261,626
Phillips County: Little Rockies	2	2	119,115	11,596	6	11,602	106,169		106,169				481,568
Powell County													
Big Blackfoot	4	3	242	132	370	502	173	76	249		100		17,753
Nigger Hill	11	1	670	278	1	279	7,418		7,418	3,400	40,000		17,721
Ophir	1	6	61	98	36	134	59	7	66	1,000			4,855
Pioneer	2	12	6	1	178	179	45	21	66	50	1,000		6,375
Washington Gulch	1	12	18	34	60	94	17	7	24		700		3,347
Zozell	6		4,714	2,312		2,312	47,662		47,662	2,550	111,600	44,000	124,775
Ravalli County													
Curlew	1		12,000	136		136	19,672		19,672	8,000	52,400	442,600	55,875
Overwich	1	2	132	70	2,239	2,309		121	121				80,901
Sanders County:													
Eagle	1		27,223	76		76	32,483		32,483	18,800	6,588,900	2,095,000	560,669
Plains	1		6				450		450		100		326
Revais Creek	1		2,458	66		66	367		367	92,000			13,427
Trout Creek	1		79	12		12	107		107	100	300		525
Vermillion	2	2	123	52	31	83	118	7	125	100	300		3,023
Silver Bow County													
Butte or Summit Valley	42		4,403,137	23,130		23,130	8,988,501		8,988,501	254,862,900	17,260,900	76,140,400	43,969,596
Divide Creek	2		32				111		111				79

German Gulch		1			4	4							140
Highland	2		18, 340	6, 318		6, 318	519		519				221, 499
Independence	2		88	11		11	2, 866		2, 866				2, 423
Lost Child		1			2	2							70
Melrose	2		44	4		4	1, 696		1, 696	100			1, 358
Silver Bow Creek		13			16	16							560
Stillwater County Yellowstone River		1			22	22							770
Sweet Grass County Independence	1		1	1		1							35
Toole County. Gold Butte		1			5	5							175
Total Montana	612	325	5, 642, 249	184, 864	61, 611	246, 475	12, 376, 890	10, 035	12, 386, 925	256, 072, 000	42, 518, 000	121, 420, 000	59, 181, 627

BEAVERHEAD COUNTY

Argenta district.—The Ermont Mines, Inc., operated the Ermont property throughout 1941 and produced most of the gold output in the Argenta district. The company operated its 100-ton countercurrent cyanide mill all year and treated 31,855 tons of gold ore of a lower grade than in 1940, resulting in a decline in gold output. Other important lode producers in the district were the Goldfinch and Shafer mines, which produced gold ore that was shipped crude to a smelter, and the Rosemont and Copper Bell properties, which produced crude lead ore. Some gold was recovered from the French Creek and Watson Gulch placers in 1941.

Bannack district.—Gold recovered from placer gravels made a marked gain in 1941 over that in 1940, but gold from lode mines a decided decrease. The main source of gold from lode mines in 1941 was crude gold ore shipped direct to a smelter from the New York-Montana and Gold Bug properties. The bulk of the placer gold output came from dredging by the Ralph E. Davis Syndicate on Grasshopper Creek. Equipment used comprised two draglines (one 5-cubic yard and one 1½-cubic yard) and a floating washing plant. During 1941 271,340 cubic yards of overburden were removed, and 131,035 cubic yards of gold-bearing gravel were washed, from which 2,690 ounces of gold were recovered. The Traderhorn Mining & Construction Co. operated a dry-land dredge in Dry Gulch for testing purposes. Several small sluicing operations, principally on Grasshopper Creek, recovered some gold.

Big Hole district.—Crude gold ore from the Star mine and crude lead ore from the S. S. & R. mine shipped direct to a smelter and gold ore from the North Star mine amalgamated comprised the metal output from lode mines in the Big Hole district in 1941. Some placer gold was recovered by sluicing.

Blue Wing district.—The output from the Blue Wing district in 1941 comprised shipments direct to smelters of several classes of crude ore, which included silver ore from the Federal Star, Del Monte, Silver Snow, and Single Jack properties, lead ore from the Ingersoll group, copper ore from the Cable claim, and gold ore from the Interstate property.

Bryant district.—Most of the output from the Bryant district in 1941 came from the Hecla mine and dump and consisted of 1,424 tons of crude gold-silver ore and 2,209 tons of gold-silver tailings shipped crude to smelters.

Colorado district.—The metal output of the Colorado district in 1941 was contained in lead ore shipped direct to a smelter from the H. & S. mine.

Horse Prairie district.—The bulk of the placer gold output from the Horse Prairie district in 1941 came from operations by W. C. McLeod on the Golden Leaf Placer on Jeff Davis Creek. The remainder came from operations by Associated Placers, Inc., on Jeff Davis and Horse Prairie Creeks. Both operators used dry-land dredges.

Vipond district.—The production from the Vipond district in 1941 comprised silver ore from the Lone Pine & Argyle and Aurora mines and lead ore from the Faithful mine, all shipped crude to smelters.

West Fork of Madison River district.—A dry-land dredge operated by Madison West Fork Placers supplied the placer gold output from the West Fork of Madison River district in 1941.

BROADWATER COUNTY

Backer district.—The value of the metal output from the Backer district in 1941 decreased from that in 1940, owing to a decline in placer gold production. Gold recovered by three dry-land dredges represented most of the output in 1941. The Pitcher Placer Mining Co. operated two draglines (1½ cubic yards and 1¾ cubic yards) on Boulder Bar in Confederate Gulch and handled about 90,000 cubic yards of gold-bearing gravel, averaging 23 cents in value of recoverable gold to the cubic yard washed. This operation was the largest in the district during 1941. Dry-land dredges were also operated by R. G. Woodard and C. J. Painter, both working in Confederate Gulch. The rest of the placer output came from small sluicing operations, chiefly in Confederate Gulch. Most of the lode output came from rich gold ore at the Superior mine.

Beaver district.—Lead ore rich in gold and containing considerable quantities of zinc was shipped crude to a lead smelter from the East Pacific and East Pacific Tunnel No. 4. This property, by far the most important producer in the district in 1941, was operated by lessees. The Iron Age property shipped 209 tons of crude gold ore, averaging over 2 ounces of gold to the ton, to a smelter in 1941. The 75-ton Custer flotation mill was idle in 1941, although a quantity of crude gold ore was shipped direct to a smelter from the Custer property. Other mines active in the Beaver district during 1941 included the Native Gold, which treated gold ore in a 25-ton flotation mill; the January, from which lead ore was shipped crude to a smelter; and the Kleinchmidt, from which crude silver ore was shipped direct to a smelter.

Cedar Plains district.—The value of the metal output from the Cedar Plains district in 1941 was virtually the same as in 1940. The M & M Mining Co., operating the Ohio Keating mine, was again the largest producer in the district and accounted for over 60 percent of the district total gold. In 1941 the daily capacity of the flotation mill was increased from 80 to 105 tons; in consequence, an average of 100 tons of gold ore a day was treated, producing over 6,000 tons of gold concentrates, which were shipped to a smelter. The C. G. Gold Corporation continued to operate its 100-ton flotation mill and made 3,000 tons of gold concentrates in 1941; in addition, a small quantity of gold ore was shipped direct to a smelter. Other production from the district included gold ore from the Robert E. Lee mine and lead ore from the Joe Dandy mine, all shipped crude to a smelter. Some placer gold was recovered from the Bald Eagle claim in Johnny's Gulch.

Park district.—The value of the metal production from the Park district in 1941 increased materially over that in 1940, owing entirely to the gain in output from placer operations by the Cooley Gravel Co. and Douglas Placers. The Cooley Gravel Co. operated from March to the middle of December 1941 and washed about 673,000 cubic yards of gold-bearing gravel from Indian Creek. The equipment consisted of a Bodinson all-electric floating washing plant, supplied with gravel by a 3-cubic yard dragline. The Douglas Placers, operating the Wilson Placers on Indian Creek, used two dragline excavators, which supplied gravel to a dry-land dredge. During 1941 the company washed approximately 500,000 cubic yards of gold-bearing gravel, which averaged 22 cents per cubic yard in value of recoverable gold.

The remainder of the placer output came from several small sluicing operations, principally on Indian Creek. The Marietta Mines shipped considerable lead ore and gold ore crude to smelters and produced most of the metal output from lode mines. Gold ore from the Little Giant mine and lead ore from the W. A. Clark mine shipped crude to smelters and gold ore amalgamated comprised most of the remaining district output in 1941.

CASCADE COUNTY

Montana district.—The Montana district showed a decided increase in output of silver, lead, and zinc in 1941 over 1940; it was the second-largest silver-producing district in the State. The Klies Mining Co., largest producer of lead and zinc in the district, operated throughout 1941. The 70-ton flotation mill was increased to 80-ton daily capacity and treated 29,120 tons of zinc-lead ore that contained about 150 ounces of gold, 150,000 ounces of silver, 20,000 pounds of copper, 2,200,000 pounds of lead, and 3,500,000 pounds of zinc. The concentration mill was operated 7 days a week, 3 shifts a day. The Lexington Mining Co. operated its 100-ton flotation mill the entire year and treated 32,718 tons of silver ore, which yielded most of the silver and gold output of the district. The Florence Mining Co. was active throughout 1941 and treated 14,664 tons of silver ore in its 75-ton flotation mill, which made lead concentrates. Lead ore from the Star group was treated in a 35-ton flotation mill by the New London Mining Corporation; the production totaled about 400 tons of lead concentrates. The Queen Leasing Co. operated its 60-ton flotation mill throughout 1941 and treated 18,500 tons of zinc-lead ore, which contained 77,700 ounces of silver, 555,000 pounds of lead, and 1,554,000 pounds of zinc. The property was closed in March 1942. Additional production from mines in the district included gold-silver ore from the Spotted mine, silver ore from the Benton group, and lead ore from the Champion "B," all shipped crude to a smelter.

DEER LODGE COUNTY

Georgetown district.—Gold ore from the Holdfast-Southern Cross group, treated by cyanidation, made up most of the output from the Georgetown district in 1941. The Sentinel Mines, Inc., working this group, operated its 65-ton countercurrent cyanidation mill throughout 1941 and treated 17,180 tons of ore. The metal output was somewhat less than in 1940. A small quantity of gold ore from the Cable mine was treated by amalgamation in 1941. The rest of the production from the district was gold ore shipped crude to a smelter; it came from several small producers, among which the Hub mine was the most important. A little placer gold was recovered from sluicing operations.

Heber district.—Gold ore from the Spain mine and a little gold from sluicing in First Chance Gulch comprised all the output from the Heber district in 1941.

Oro Fino district.—The output from the Oro Fino district in 1941 was crude silver ore shipped to smelters from the Champion and Cashier groups.

Silver Lake district.—Silver ore was shipped crude to smelters from the Silver Reef and Chloride Silver properties in 1941.

Smelter district.—Some copper ore clean-up and slimes from the Anaconda plant were shipped to Washoe.

FERGUS COUNTY

Cone Butte district.—Gold ore cyanided, from the Thomas and Old Glory mines, made up the output from the Cone Butte district in 1941.

North Moccasin district.—The North Moccasin Mines Syndicate treated 75,535 tons of gold ore from the Barnes-King open-cut mine by cyanidation in 1941. The ore contained 3,777 ounces of gold and 1,510 ounces of silver and yielded 2,715 ounces of gold and 1,080 ounces of silver. The cyanidation mill had a daily capacity of about 600 tons. A little placer gold was recovered from the Grubstake claim in 1941.

Warm Springs district.—The output from the Warm Springs district was copper ore from the Globe mine, gold ore from the Gold Crop mine, and silver ore from the Mickey mine, all shipped crude to smelters.

FLATHEAD COUNTY

Hog Heaven district.—The Flathead mine, owned and operated by the Anaconda Copper Mining Co., shipped 17,600 tons of silver ore and 14,926 tons of lead ore crude to smelters in 1941; it was one of the most important lead-producing mines in the State. The rest of the district production was contained in silver ore from the Birdseye mine and copper ore from the Flag-Martin mine, all of which was shipped crude to a smelter.

GALLATIN COUNTY

The output from Gallatin County in 1941 came from sluicing at the Jewel Placer in the Eldridge district.

GRANITE COUNTY

Alps district.—Most of the output from the Alps district in 1941 consisted of crude gold ore from the Rainy Day mine, shipped direct to a smelter.

Boulder district.—The Gold King mine, operated by lessees, was the chief producer in the Boulder district in 1941. Among other producers were the Apex mine, which shipped gold ore direct to a smelter, and the Saranac, which shipped zinc ore to the Anaconda zinc concentrator for treatment. Sluicing in Princeton Gulch recovered some gold.

Dunkleberg district.—Zinc-lead ore from the Forest Rose mine, treated by flotation concentration in a new 100-ton mill, comprised virtually all the output of the Dunkleberg district in 1941. The 100-ton mill, which was erected adjacent to the mine during the latter part of 1940, was put into operation on January 12, 1941, and continued for the remainder of the year. During this period it treated 18,766 tons of ore and made zinc concentrates and lead concentrates, which were shipped to Anaconda and East Helena smelters, respectively. The rest of the district output was gold-silver ore shipped crude to a smelter.

Flint Creek district.—Old tailings from the Granite-Bimetallic mine, operated by the Philipsburg Mining Co. in 1941, were again the chief

source of metal output from the Flint Creek district. The tailings were shipped direct to Tacoma and Washoe and there used chiefly for fluxing. The Kroger Lease of the Moorlight Mining Co. operated the Headlight mine and shipped 1,547 tons of gold-silver ore crude to a smelter, and the Moorlight Mining Co. operated the Climax mine and shipped lead smelting ore crude. Zinc-lead ore was shipped to the Anaconda zinc concentrator from the Silver Prince and Trout properties in 1941 by the Contact Mines Corporation and the Trout Mining Division of American Machine & Metals, Inc., respectively. In addition, the Contact Mines Corporation shipped a large quantity of silver ore crude to Washoe.

Gold Creek district.—The output from the Gold Creek district in 1941 was placer gold, nearly all of which was recovered by the Master Mining Co. from upper Gold Creek.

Henderson district.—The lode output of the Henderson district comprised silver ore from the Black Pine mine and dump and gold ore from the Sunrise mine. The placer gold output came from a dry-land dredge operated by H. J. Schneider & Bros. on the New Deal placer.

Maxville district.—Lead ore from the Blue Bird mine and gold ore from the Evergreen mine were shipped to East Helena in 1941.

Red Lion district.—The Red Lion Mining Co. cyanided gold ore from the Hidden Lake property and recovered most of the gold output of the Red Lion district in 1941. The rest of the output was crude gold smelting ore from the Lila Dixon and Surprise groups.

Rock Creek district.—The Normac Corporation built a 25-ton cyanide plant during 1941 and treated some gold ore from the Ella mine. Other lode production from the Rock Creek district was gold ore from the Shakespeare mine. Some placer gold was recovered.

JEFFERSON COUNTY

Amazon district.—Lead ore was shipped crude to a smelter in 1941 from the East Mint mine and the Anna Carmen dump.

Bigfoot district.—A small lot of gold ore from the Grass Root property was shipped to a smelter in 1941.

Boulder district.—Ore was shipped crude to a smelter in 1941 from several properties in the Boulder district, including gold-silver ore from the Adolphus, silver ore from the Baltimore, and lead ore from the Ing, Esperanzie, and St. John properties. Some gold was produced from placers near Boulder.

Cataract district.—The total value of the metal output of the Cataract district in 1941 decreased materially from 1940, owing almost entirely to the closing of the Comet property by the Basin Montana Tunnel Co., in April 1941. As commercial ore was exhausted, the 200-ton flotation mill on the property was idle for the remainder of 1941. The Boulder, Bullion, Crystal, Deer Lodge, Morning Glory, and Red Eagle mines were among the other lode producers in the district in 1941. Some gold was recovered by sluicing near Boulder.

Clancey district.—The metal output from the Clancey district in 1941 again came largely from placer operations. The Winston Bros. Co. continued to operate its 6-cubic foot electrically powered Yuba dredge throughout 1941. The dredge handled 2,157,277 cubic yards of gravel compared with 1,880,436 in 1940. The company again was the leading placer gold producer in Montana. The Williams Construction Co., operating a dry-land dredge near Clancey, ranked second.

The Jefferson Placers and O. A. Barnes operated dry-land dredges on Clancey Creek and Holmes Creek, respectively. A total of 28,700 cubic yards of gravel was washed, which averaged about 75 cents in value of recoverable gold per cubic yard. The remainder of the placer production in the district came from sluicing, chiefly in Lump Gulch. The lode production was ore shipped crude to smelters; it came from the Frohner, Our Ticket 45, Panama, and Paragraph mines.

Colorado district.—Eathorne & Fox, again the leading producers in the Colorado district, treated zinc-lead tailings from the Alta dump in 1941. The mill, which treated 29,607 tons of tailings in 1941, made 1,391 tons of lead concentrates and 40 tons of zinc concentrates. The Blue Bird mine shipped crude to Washoe 2,038 tons of gold-silver ore containing 714 ounces of gold and 20,884 ounces of silver. Other mines active in 1941 included the Buckeye, Blizzard, Custer, and Pen Yan.

Elkhorn district.—The only production in the Elkhorn district in 1941 was lead ore and gold ore shipped crude to smelters from the C & D, Elkhorn, Klondyke, and Little Goldie mines.

Golconda district.—The output from the Golconda district in 1941 was gold, silver, and lead ores shipped crude to smelters.

Homestake district.—Gold and gold-silver ore shipped direct to smelters formed the lode mine output in 1941. The Payrock mine was the largest producer. Some gold was recovered by sluicing on Betty Creek.

Lowland district.—Placer gold comprised the bulk of the output from the Lowland district in 1941, and the Kit Carson Placers produced virtually the entire output. The company operated a dry-land dredge from May through September and washed 170,000 cubic yards of gold-bearing gravel, which averaged 22 cents per cubic yard in recoverable gold. In addition, the company removed 354,000 cubic yards of overburden preparatory to dredging. Lode production came from the Montreal and Infinite groups.

Mitchell district.—Gold ore shipped crude to smelters was the output from the Mitchell district in 1941.

Warm Springs district.—Gold-silver ore was shipped crude to a smelter from the Greenleaf dump in 1941.

Whitehall district.—The Golden Sunlight mine, operated by lessees, was the largest producer in the Whitehall district in 1941; it shipped 5,105 tons of gold ore containing 3,075 ounces of gold and 4,142 ounces of silver. Among the other producers were the Florence, Lucky Hit, Ivans, and Sunny Corner mines.

Willow Creek district.—The output from the Willow Creek district in 1941 was lead ore shipped crude to a smelter and gold ore amalgamated and concentrated from the Callahan group (Deer Horn).

JUDITH BASIN COUNTY

Barker district.—The output of the Barker district in 1941 was lead ore shipped crude to East Helena from the Glendennin group and the Marcelline and Silver & Bell mines.

Yogo district.—Gold ore from the Gold Bug mine and copper ore from the Blue Dick mine, shipped crude to Washoe, comprised the only output in the Yogo district in 1941.

LEWIS AND CLARK COUNTY

Blue Cloud district.—One lot of lead ore was shipped to East Helena from the Lincoln mine in 1941.

Dry Gulch district.—The Golden Messenger mine was operated throughout 1941 by the Golden Messenger Corporation. The output was about 50,000 tons of gold ore cyanided in the company 150-ton mill. The bullion produced yielded 7,307 ounces of fine gold and 6,030 ounces of fine silver. The property was closed in March 1942. A little placer gold was recovered by sluicing.

Heddleston district.—The value of the metal output of the Heddleston district in 1941 increased substantially over that of 1940, owing entirely to work by the Mike Horse Mining & Milling Co. The company operated its 150-ton flotation mill throughout 1941 except for the months of April, May, and June. During the operating period, about 27,000 tons of zinc-lead ore were treated, producing about 1,500 tons of lead concentrates and 1,300 tons of zinc concentrates. Production figures based upon the first quarter of 1942 indicate that the property is exceeding its 1941 rate. Other producers in the district were the Carbonate, Mazuma, and Consolation mines.

Helena district.—Placer gravel remained the chief source of mineral value in the Helena district in 1941. By far the largest part of the placer gold output came from dredging by Porter Bros. Corporation. The 6-cubic foot electric-powered bucket dredge operated throughout 1941 in Last Chance Gulch near Helena and treated 1,864,078 cubic yards of gravel. A small dry-land dredge was operated on the Travis Placer from April to the middle of May. The rest of the placer gold output came from several small sluicing operations. The lode output came from several small lode mines; the most important were the Court House, Whitlatch, and Spring Hill.

Jefferson Gulch district.—A little placer gold was recovered by sluicing in Jefferson Gulch.

Lincoln district.—Placer gold contributed the major part of the metal output from the Lincoln district in 1941; it was recovered by sluicing, principally in Lincoln, McClellan, and Sauerkraut Gulches. The lode output came from gold ore amalgamated and gold ore shipped crude to smelters.

Marysville district.—Lode mines produced the bulk of metal values from the Marysville district in 1941. The Martin Mining Co., again the leading producer, treated 36,350 tons of old tailings from the Eck mine in its 125-ton roasting and cyaniding mill. The tailings were excavated by power shovels and trucked about 1 mile to the mill. The J. C. Archibald Co. treated old tailings from the Bald Butte mine, but the quantity of gold recovered was less than in 1940. Lessees operated the Shannon group and shipped crude to Washoe 743 tons of gold ore, which contained 606 ounces of gold and 403 ounces of silver. Several groups of lessees operated the St. Louis Drumlummon mine in 1941 and shipped gold ore crude to smelters. The Rex Mining Co. treated gold-silver ore in its 35-ton flotation mill and made 71 tons of lead concentrates. Among the other producers in the district were the Penobscot mine, Piegan-Gloster group, and Golden Gate mine.

Missouri River district.—The Perry-Schroeder Mining Co. continued to operate its 6-cubic foot electrically driven Yuba dredge on the

Missouri River 15 miles north of Helena throughout 1941 and handled 1,873,400 cubic yards of gold-bearing gravel.

Ophir Gulch district.—Gold ore was shipped crude to a smelter from the Nora Darling mine in 1941.

Rimini district.—The bulk of the lode production in the Rimini district in 1941 came from the Armstrong mine, which shipped lead ore crude to East Helena. The rest of the lode output of the district was ore shipped crude to smelters, chiefly from the Eureka and Porphyry Dike mines. A dry-land dredge, operated by N. Rogers on the Gould Placer near Rimini in 1941, contributed the major part of the placer gold output.

Scratch Gravel district.—Ore shipped crude to a smelter from the Franklin and Julia mines and gold ore amalgamated from the Umatilla mine comprised the output from the Scratch Gravel district.

Silver City district.—The output from the Silver City district was old tailings amalgamated from the Albert Brown mine.

Smelter district.—The fuming plant owned by the Anaconda Copper Mining Co. continued throughout 1941 to treat slag from the lead smelter of the American Smelting & Refining Co. at East Helena. The value of the zinc fume produced was $1,250,130 greater than that produced in 1940.

Stemple district.—The Gould mine operated by the Standard Silver-Lead Mining Co. again produced the bulk of the output in the Stemple district. In 1941, 27,871 tons of ore and old tailings were cyanided in the 75-ton cyanide plant. The bullion shipped to the Seattle Assay Office contained 4,720 ounces of fine gold and 20,137 ounces of silver. Among other mines active in the Stemple district in 1941 were the New Silver Bell, Bachelor, Homestake, and Hubbard. A little gold was recovered by sluicing, principally in Canyon Creek.

LINCOLN COUNTY

Libby district.—The Courageous Mining Co. treated 17,239 tons of gold ore from the Branagan mine in its 150-ton amalgamation and flotation-concentration mill. The Glacier Silver-Lead Mining Co. milled 6,443 tons of gold-silver ore from the Lukens Hazel mine, which made 142 tons of lead concentrates. The Snowshoe Mines, Inc., treated zinc-lead ore in its 100-ton flotation mill; it made 162 tons of lead concentrates and 31 tons of zinc concentrates. Two other mills active in the Libby district in 1941 were the 50-ton Midas mill, which treated gold ore from the Midas mine, and the 25-ton Tip Top mill, which treated gold ore from the New Deal property. The rest of the lode output was lead ore from the Silver Butte and gold ore from the Merrie claim, all shipped crude to smelters. Some gold was recovered by sluicing, chiefly on Libby Creek.

MADISON COUNTY

Norris district.—The Boaz mine operated its 50-ton cyanide and concentration mill throughout 1941 and treated both company and custom gold ore. The mill treated 13,415 tons of gold ore from company properties, which yielded 5,145 ounces of gold and 3,178 ounces of silver in bullion and 1,879 ounces of gold and 806 ounces of silver in gold concentrates. The Grubstake mine, second-largest producer in the Norris district, shipped about 500 tons of rich gold ore to Washoe

in 1941. The Revenue mine operated only the first part of 1941 but ranked third in lode gold output in the district. Among other lode mines making sizable production in 1941 were the Madisonian, Heleene, New York Belle, and Emperor. Nearly the entire placer output from the district in 1941 came from the operation of a bucket dredge on the Norwegian Placer by Homer Wilson. The dredge is equipped with 5-cubic foot buckets and washed 150,000 cubic yards of gravel, from which 1,490 ounces of fine gold were recovered—a slight increase over 1940.

Pony district.—The output of the Pony district decreased sharply in 1941 from 1940, owing chiefly to inactivity of the Atlantic-Pacific group. The bulk of the output in 1941 came from the Mammoth mine, from which 17,585 tons of gold ore were concentrated, making copper concentrates containing 3,460 ounces of gold, 5,646 ounces of silver, and 80,353 pounds of copper. Among the other producers in the district were the Boss Tweed & Clipper and Ridgeway mines. A little placer gold was recovered by sluicing.

Renova district. — The West Mayflower mine, owned and operated by the Anaconda Copper Mining Co., was again the largest gold producer in Montana; in 1941 it produced 19,166 tons of gold ore shipped crude to Washoe and containing 19,760 ounces of gold and 135,026 ounces of silver. The Mary Ingaber mine was operated by lessees.

Rochester (Rabbit) district.—The Lively Mining Co., operating the Hidden Treasure mine, was the largest producer in the Rochester district during 1941. Ore was shipped direct to smelters from several small mines.

Ruby Creek district.—A dry-land dredge recovered some gold in 1941 from tests on Gumbo Flats.

Sheridan district.—The Sheridan Gold Mining & Milling Co., operating the Uncle Sam, Toledo group, and Occidental properties in 1941, was again the largest producer in the Sheridan district. Gold ore was shipped crude from the Uncle Sam and Occidental mines, and lead ore was shipped crude from the Toledo group. Production was reported from 27 other lode mines in the district. The Traderhorn Mining & Construction Co. produced most of the placer gold recovered in the district in 1941. The company tested the Sievers Placer in California Gulch and used a dry-land dredge.

Silver Star district.—The Victoria Mines, Inc., operated the Broadway mine and its 125-ton cyanide plant throughout 1941. The company treated 39,273 tons of gold ore in its mill and in addition shipped 654 tons of gold ore crude to smelters. The Green Campbell property, operated by the Green Campbell Mining Co., ranked second in gold output in the Silver Star district. During 1941 the company treated 6,731 tons of gold ore in its 25-ton amalgamation-concentration mill; this ore yielded 202 ounces of gold in amalgamation bullion and 988 ounces of gold in gold concentrates. The Golden Rod Mining Co. shipped crude to a smelter 490 tons of gold ore, which averaged over 2 ounces of gold to the ton. Among the other lode producers in the district in 1941 were the Aurora and Edgerton, both shipping gold ore crude to Washoe.

Tidal Wave district.—The metal output of the Tidal Wave district in 1941 came from several small lode mines and was mostly gold ore shipped crude to smelters. The most important producers were the High Ridge mine, Pollinger group, and Smith and Agitator mines.

Virginia City district.—There were 34 lode mines active in the Virginia City district in 1941. The five leading mines—East & West Mapleton, Bartlett, and Alameda mines and the Prospect and Easton-Pacific groups—produced an aggregate of 10,203 tons of gold and gold-silver ore, which contained 3,247 ounces of gold and 41,110 ounces of silver. Among the other leading producing lode mines were the U. S. Grant, Apex, Gold Bar, Marietta, and St. John properties. The Howe Dredging Co. was the largest producer of placer gold in the district in 1941. The equipment consisted of a dry-land dredge, and during 1941 about 20,000 cubic yards of gravel were washed. Several sluicing operations also were active in the district, of which the most important were the E. D. Howe operation in Wisconsin Gulch and the G. Gosta Miller operation in Cottonwood Creek.

Washington district.—The Gold Creek Mining Co. operated its floating connected-bucket dredge for 9 months of 1941 and recovered 1,785 fine ounces of gold from 499,010 cubic yards of gravel. The dredge is electrically powered and has sixty-two 4½-cubic foot buckets. The lode production in the Washington district came from gold ore shipped direct to a smelter, principally from the Missouri McKee mine.

MEAGHER COUNTY

Beaver Creek district.—The output from the Beaver Creek district in 1941 came mostly from operations of three dry-land dredges. The largest producer was the dredge operated by the T. C Mines on Thomas Creek which handled 21,400 cubic yards of gravel and recovered 112 ounces of gold.

Camas Creek district.—Some gold was recovered by sluicing.

Carbonate district.—Some copper ore was shipped direct to a smelter from the Peterson Waite mine.

MINERAL COUNTY

Cedar Creek district.—The bulk of the placer gold output in the Cedar Creek district in 1941 came from dry-land dredging by the Superior Mines Co. The rest came from several small sluicing operations.

MISSOULA COUNTY

Coloma district.—Gold ore shipped crude to smelters was the chief source of metal output in the Coloma district in 1941. The Mammoth & East Mammoth, Dixie, and Dandy mines were the chief producers.

Copper Cliff district.—Gold ore from the Copper Cliff mine was the only output from the Copper Cliff district in 1941.

Elk Creek district.—A little placer gold was recovered by sluicing.

Nine Mile district.—The Weaver Dredging Co. operated a dragline dredge on Nine Mile Creek from March to May 19; on May 19, this company was dissolved and the Beaver Dredging Co., a partnership, resumed the operations. The new partnership also operated a dry-land dredge on Nine Mile, Josephine, and McCormick Creeks. In all, 506,187 cubic yards of gold-bearing gravel from these operations were treated; 2,858 fine ounces of gold were recovered. The rest of the placer gold output was from sluicing, mainly on McCormick Creek.

PARK COUNTY

Emigrant Creek district.—The Emigrant Dredging Co. operated a floating electrically powered connected-bucket Yuba dredge, equipped with 110 10-cubic foot buckets, in Emigrant Gulch from August 15 to December 31, 1941; as a result, the output from the Emigrant Creek district increased sharply over 1940. During its period of activity the dredge washed 558,000 cubic yards of gravel. The remaining district output came from several small sluicing operations.

New World district.—The McLaren Gold Mines Co., operating the Estelle property throughout 1941, milled 19,000 tons of gold ore, which made 675 tons of copper concentrates, containing about 6,500 ounces of gold, 5,000 ounces of silver, and 103,000 pounds of copper. The capacity of the mill was increased to 200 tons a day, and in 1942 the production is expected to reach 1,000,000 pounds of copper in concentrates containing substantial quantities of gold. The Irma Mines, Inc., treated zinc-lead ore in its 30-ton flotation mill and produced lead and zinc concentrates. In addition, the company shipped 164 tons of lead ore crude to East Helena. Some placer gold was recovered by sluicing.

Sheepeater (Jardine) district.—The Jardine Mining Co. operated the Jardine mine all of 1941. The company amalgamation and concentration mill treated 69,324 tons of gold ore, from which 7,436 ounces of gold were recovered. Gold ore shipped crude to a smelter totaled 145 tons. Extra equipment was installed in the mill during 1941, and surface mining was adopted in addition to underground mining.

PHILLIPS COUNTY

Little Rockies district.—The Ruby Gulch Mining Co. operated the Ruby Gulch mine throughout 1941 and treated 94,244 tons of gold ore by straight cyanidation. The 300-ton cyanide mill was operated at capacity all year. The Little Ben mine produced 24,847 tons of gold ore, which was cyanided by the Little Ben Mining Co. in its 150-ton mill. The mill was operated in 1941 at the rate of two shifts a day for 5 months and one shift a day for 7 months.

POWELL COUNTY

Big Blackfoot district.—The Western Montana Gold Mining Co. operated the Blackfoot Group intermittently during 1941, treated gold ore in its 30-ton concentration mill, and also shipped gold ore crude to Washoe. Other lode production in the Big Blackfoot district included gold ore amalgamated from the Sweepstake mine. Placer gold was recovered by sluicing on McCormick Creek.

Nigger Hill district.—Gold-silver ore concentrated from the Old Monarch mine represented virtually all the lode output from the Nigger Hill district in 1941. Some placer gold was recovered by sluicing.

Ophir district.—Gold ore smelted from the Victory claim and placer gold recovered from several small sluicing operations comprised the output from the Ophir district in 1941.

Pioneer district.—The bulk of the output in the Pioneer district in 1941 came from hydraulic operations by Francis Slaughtner and dry-land dredging operations by the Master Mining Co., both at Gold Creek. The Pioneer Placer Dredging Co. did not resume operations

after closing down in 1940. Some lead ore was shipped crude to East Helena.

Washington Gulch district.—A dry-land dredge operated on the Peacock Placer in Washington Gulch in 1941. Gold ore was shipped crude from the Grey mine to a smelter.

Zozell (Emery) district.—Crude gold, gold-silver, and lead ores from the Bonanza and Emery Consolidated mines contributed the bulk of the metal output of the Zozell district in 1941. In addition, the Emery Consolidated shipped zinc-lead ore to the Midvale concentrator in Utah. Other important producers were the Blue-Eyed Maggie, Emma Darling, and Hidden Hand mines; all shipped ore crude to smelters in 1941.

RAVALLI COUNTY

Curlew district.—The output from the Curlew district in 1941 came from the Curlew mine. Zinc ore was concentrated and over 500 tons of zinc concentrates were shipped to a smelter.

Overwich district.—The J. L. Shiely Co. operated a dragline dredge from March 27 to November 30, washed 376,920 cubic yards of gravel, and recovered 2,237 fine ounces of gold. The equipment comprised a Bodinson floating washing plant and a 2½-cubic yard dragline. Some gold ore from the Washington mine was amalgamated.

SANDERS COUNTY

Eagle district.—The Jack Waite mine extends over the State line into Idaho. The property was operated throughout 1941 by the American Smelting & Refining Co. During this period the company treated (in its 300-ton flotation mill) 25,967 tons of zinc-lead ore containing 27,006 ounces of silver, 5,395,943 pounds of lead, and 2,783,662 pounds of zinc; the concentrates produced amounted to 3,136 tons of lead concentrates and 2,195 tons of zinc concentrates. In addition, 1,256 tons of lead ore, which contained about 1,775,000 pounds of lead and 7,585 ounces of silver, were shipped crude to East Helena.

Revais Creek district.—Copper ore from the Drake property was concentrated in 1941 by the Green Mountain Mining Co. in its 50-ton flotation mill. In addition to the concentrates produced, 118 tons of copper ore, containing 19 ounces of gold, 136 ounces of silver, and 34,451 pounds of copper, were shipped direct to Washoe.

Other districts.—Production was reported from the Dog Lake mine in the Plains district, the Ambassador mine in the Trout Creek district, and the Shoestring No. 1 and No. 2 and Razorback mines in the Vermillion district.

SILVER BOW COUNTY

The total value of the metal output from mines in Silver Bow County in 1941 gained $3,324,006 over 1940; all metals except lead made gains, owing to increased production of copper and zinc-lead ores at Butte. The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1940 and 1941 and the total from 1882 to the end of 1941.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1940–41, and total, 1882–1941, in terms of recovered metals

	Mines producing	Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1940	58	3,764,610	25,107	8,766,398	250,884,000	17,718,500	71,798,000	$40,871,719
1941	50	4,421,641	29,485	8,993,693	254,863,000	17,260,900	76,140,400	44,195,725
1882–1941	----	(1)	1,952,811	517,777,237	(2) 6,006,680	(2) 215,736	(2) 1,509,891	2,418,107,139

[1] Figures not available.
[2] Short tons.

Butte or Summit Valley district.—All productive mines of the Anaconda Copper Mining Co. at Butte were brought up to capacity during 1941, with the result that the output of all metals but lead increased. Lead production was slightly less than in 1940. In 1941, 2,869,051 tons of copper ore were sent to the copper concentrator at Anaconda compared with 2,737,572 tons in 1940, and 4,500 tons of mine-water precipitates were treated compared with 3,812 in 1940. In addition, the copper concentrator at Anaconda treated 405,862 tons of mine-dump material averaging about 1 percent copper and 512,930 tons of Old Works tailings and Upper Old Works tailings averaging slightly over 1 percent copper. Crude ore smelted totaled 36,596 tons, and tailings 32,881 tons. All zinc mines of the Anaconda Copper Mining Co. operated throughout 1941; the output consisted of 472,133 tons of zinc-lead ore treated at the Anaconda zinc concentrator compared with 362,479 tons in 1940. Development comprised at the copper mines 210,045 feet of drifts, 1,492 feet of shafts, and 20,599 feet of diamond drilling; at all zinc mines, 27,653 feet of drifts, 772 feet of shafts, and 2,414 feet of diamond drilling. Operations were continued throughout 1941 at the Emma mine, leased from the Butte Copper & Zinc Co. by the Anaconda Copper Mining Co. The production—36,329 tons of zinc-lead ore compared with 77,353 tons in 1940—was treated at the Anaconda zinc concentrator. The output of the company included 12,193 tons of zinc-lead sulfide concentrates (zinc-lead middlings). The sulfide concentrates were re-treated at the Anaconda zinc concentrator.

Lessees of the Anaconda Copper Mining Co. operated several company properties; the most productive were the Poulin, which produced over 3,000,000 pounds of zinc, and the Black Rock group, which produced 9,973 tons of silver ore.

Divide Creek district.—Small lots of silver ore were shipped crude to Washoe in 1941.

Highland district.—The Butte Highlands Mining Co. operated the Highlands group (Tilton) in 1941 and treated 18,339 tons of gold ore in its 75-ton cyanide plant. The ore yielded 6,317 ounces of gold and 517 ounces of silver.

Independence district.—Silver ore was shipped crude to Washoe from the Deadwood and Goldflint mines in 1941.

Melrose district.—Small lots of silver ore were shipped from the Galla Nipper and Olson properties in 1941.

Silver Bow Creek district.—Some gold was recovered from sluicing on Silver Bow Creek in 1941.

STILLWATER COUNTY

Placer gold was recovered by sluicing in the Gold Butte district in 1941.

TOOLE COUNTY

Yellowstone River district.—A dry-land dredge operated on gravel bars along the Yellowstone River in 1941 and recovered some gold.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

SUMMARY

The total value of gold, silver, copper, lead, and zinc recovered from ores, old tailings, and gravels in Nevada in 1941—$38,959,420—was greater than in any year since 1918 (see fig. 1). Gold production decreased in 1941 compared with 1940, but both quantity and value of each of the other four metals increased. Copper production—157,822,000 pounds—exceeded all years but 1928, which was greater by only 1,054,883 pounds. Gold decreased 5 percent in both quantity and value; silver increased 13 percent in both quantity and value, copper 1 percent in quantity and 5 percent in value, lead 28 percent in quantity and 46 percent in value, and zinc 28 percent in quantity and 52 percent in value. The total value of the five metals was 5 percent greater than in 1940; of this total value, copper comprised 48 percent, gold 33, silver 10, zinc 6, and lead 3 percent.

White Pine County continued in 1941 to be the largest contributor to the mineral output of the State; it ranked again first in copper and second in gold and was third in silver. Humboldt County was again the leading gold producer. Lincoln County led in silver and again in lead and zinc.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1937: Yearly average weighted Treasury buying price for newly mined silver, 1938-41 Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1937–41, and total, 1859–1941, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	682	117	7,565,466	281,332	$9,846,620	4,864,750	$3,762,884
1938	795	130	5,880,021	296,434	10,375,190	4,355,471	2,815,658
1939	891	104	6,894,999	361,518	12,653,130	4,316,029	2,929,668
1940	895	115	8,338,259	383,933	13,437,655	5,175,928	3,680,660
1941	799	178	8,799,635	366,403	12,824,105	5,830,238	4,145,947
1859–1941 [2]	-------	-------	(3)	24,775,446	545,702,286	580,706,330	534,278,401

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	149,206,000	$18,053,926	18,694,000	$1,102,946	28,472,000	$1,850,680	$34,617,056
1938	92,338,000	9,049,124	9,358,000	430,468	17,888,000	858,624	23,529,064
1939	133,194,000	13,852,176	8,472,000	398,184	12,456,000	647,712	30,480,870
1940	156,908,000	17,730,604	14,998,000	749,900	23,666,000	1,490,958	37,089,777
1941	157,822,000	18,622,996	19,246,000	1,097,022	30,258,000	2,269,350	38,959,420
1859–1941 [2]	[4] 1,465,494	420,494,522	[4] 516,959	55,108,383	[4] 258,839	35,463,284	1,591,046,876

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property

[2] Compiled by Chas W. Henderson, supervising engineer, field offices, Denver, Colo. From 1904 (when first satisfactory annual canvass of mine production was made) to 1941, inclusive, the output was as follows: Gold, 12,948,569.51 ounces, valued at $301,219,053, silver, 292,293,481 ounces, $197,120,178, copper, 1,463,568 tons, $419,847,894, lead, 279,168 tons, $32,471,821, zinc, 258,839 tons, $35,463,284, total value, $986,122,230.

[3] Figures not available

[4] Short tons.

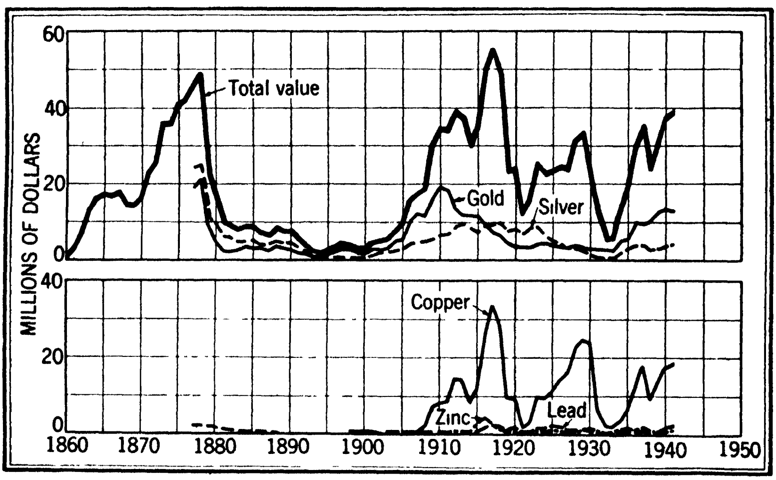

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860–1941

Gold.—Almost three-fourths of the recoverable gold output of Nevada in 1941 was derived from dry ores, chiefly gold ore, and virtually all the gold from base-metal ores came from copper ore; placer gold constituted 10 percent of the total. Five companies produced 45 percent of the State total gold, and the 10 leading gold-producing mines listed in the following table supplied 60 percent. Five of the

mines listed (Getchell, Manhattan dredge, Northumberland, Gold Standard, and Dayton dragline dredge) have begun production since March 1, 1938; together they produced 32 percent of the State total in 1941.

Ten leading gold-producing mines in Nevada in 1941, in order of output

Rank	Mine	District	County	Rank in 1940	Operator	Source of gold
1	Getchell	Potosi	Humboldt	1	Getchell Mine, Inc.	Gold ore.
2	Ruth and Copper Flat Pit.	Robinson	White Pine	3	Nevada Consolidated Copper Corporation.	Copper ore.
3	Coppermines group.	do	do	2	Consolidated Coppermines Corporation.	Do.
4	Manhattan dredge	Manhattan	Nye	4	Manhattan Gold Dredging Co.	Dredge.
5	Mary	Silver Peak	Esmeralda	5	Prescott Lease (E. L. Cord)	Gold ore.
6	Gold Standard	Imlay	Pershing	8	Standard Cyaniding Co.	Do.
7	Northumberland	Northumberland	Nye	7	Northumberland Mining Co	Do.
8	Overman	Comstock	Storey	9	Consolidated Chollar Gould & Savage Mining Co.	Do.
9	Dayton dredge	Silver City	Lyon	(1)	Dayton Dredging Co.	Dragline dredge.
10	Keystone	Comstock	Storey	6	Dayton Consolidated Mines Co. and lessees.	Gold ore.

[1] Operation began Jan. 1, 1941.

Silver.—The 10 leading silver-producing mines in Nevada in 1941, listed in the following table, produced 57 percent of the State total recoverable silver; the first 2 yielded almost one-fourth of the total. As in preceding years, most of the silver was a byproduct of ore mined chiefly for other metals; only 21 percent was derived from straight silver ore.

Ten leading silver-producing mines in Nevada in 1941, in order of output

Rank	Mine	District	County	Rank in 1940	Operator	Source of silver
1	Nivloc	Silver Peak	Esmeralda	1	Desert Silver, Inc.	Silver ore.
2	Pioche Nos. 1 and 2.	Pioche	Lincoln	2	Combined Metals Reduction Co.	Zinc-lead ore.
3	Pansy Lee	Barrett Springs	Humboldt	25	West Coast Mines, Inc.	Gold-silver ore.
4	Mizpah	Tonopah	Nye	3	Various lessees	Do.
5	Bristol Silver	Jack Rabbit	Lincoln	9	Bristol Silver Mines Co.	Lead ore.
6	Dan Tucker	Sand Springs	Churchill	4	Summit King Mines, Ltd.	Gold-silver ore
7	El Dorado-Rover group.	Eldorado Canyon.	Clark	6	El Dorado-Rover Mining Co.	Do.
8	Crown Point	Comstock	Storey	7	Sutro Tunnel Coalition, Inc.	Do
9	Overman	do	do	8	Consolidated Chollar Gould & Savage Mining Co.	Gold ore.
10	Gore	Taylor	White Pine	54	Various lessees	Silver ore.

Copper.—Nearly 99 percent of the recoverable copper output of Nevada in 1941 came from mines operated by the following companies: The Nevada Consolidated Copper Corporation, working the Ruth mine at Ruth and the open pit at Copper Flat (in the Robinson district, White Pine County); the Consolidated Coppermines Corporation, working the Coppermines group at Kimberly (also in the Robinson district); and the Mountain City Copper Co., working the Mountain City mine at Mountain City (in the Cope district, Elko County).

Lead and zinc.—The Combined Metals Reduction Co. in the Pioche district, Lincoln County, produced 92 percent of the recoverable zinc and 63 percent of the recoverable lead output of Nevada in 1941.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1941, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer)	
			Lode		Placer		Total			
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Churchill	28		9,586	$335,510			9,586	$335,510	443,319	$315,24
Clark	49		17,755	621,425			17,755	621,425	377,086	268,150
Douglas	2	1	15	525	11	$385	26	910	4	3
Elko	55	5	4,169	145,915	2,276	79,660	6,445	225,575	199,907	142,156
Esmeralda	65	3	34,393	1,203,755	18	630	34,411	1,204,385	794,014	564,632
Eureka	32	11	2,878	100,730	411	14,385	3,289	115,115	41,635	29,607
Humboldt	42	7	75,779	2,652,265	521	18,235	76,300	2,670,500	597,375	424,800
Lander	43	6	5,993	209,755	653	22,855	6,646	232,610	94,937	67,511
Lincoln	36		5,751	201,285			5,751	201,285	1,251,803	890,171
Lyon	47	4	6,167	215,845	10,589	370,615	16,756	586,460	45,304	32,216
Mineral	63	2	2,188	76,580	42	1,470	2,230	78,050	67,988	48,347
Nye	120	11	26,067	912,345	21,045	736,575	47,112	1,648,920	601,909	428,024
Pershing	54	22	18,562	649,670	1,204	42,140	19,766	691,810	59,957	42,636
Storey	46	1	42,975	1,504,125	6	210	42,981	1,504,335	539,058	383,330
Washoe	20		1,470	51,450	27	945	1,497	52,395	7,478	5,318
White Pine	97	5	75,758	2,651,530	94	3,290	75,852	2,654,820	708,464	503,797
	799	78	329,506	11,532,710	36,897	1,291,395	366,403	12,824,105	5,830,238	4,145,947
Total, 1940	895	115	346,021	12,110,735	37,912	1,326,920	383,933	13,437,655	5,175,928	3,680,660

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill							$650,759
Clark	4,000	$472	280,000	$15,960	860,000	$64,500	970,507
Douglas							913
Elko	21,820,000	2,574,760	1,348,000	76,836	480,000	36,000	3,055,327
Esmeralda	2,000	236	22,000	1,254			1,770,507
Eureka	4,000	472	50,000	2,850	8,000	600	148,644
Humboldt	70,000	8,260	1,002,000	57,114			3,160,674
Lander	540,000	63,720	168,000	9,576			373,417
Lincoln	926,000	109,268	15,558,000	886,806	28,782,000	2,158,650	4,246,180
Lyon	62,000	7,316					625,992
Mineral	6,000	708	244,000	13,908			141,013
Nye	12,000	1,416	386,000	22,002			2,100,362
Pershing	10,000	1,180	90,000	5,130			740,756
Storey							1,887,665
Washoe	12,000	1,416	6,000	342			59,471
White Pine	134,354,000	15,853,772	92,000	5,244	128,000	9,600	19,027,233
	157,822,000	18,622,996	19,246,000	1,097,022	30,258,000	2,269,350	38,959,420
Total, 1940	156,908,000	17,730,604	14,998,000	749,900	23,666,000	1,490,958	37,089,777

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

MINING INDUSTRY

Expansion of production at the three large copper mines in Nevada in 1941 explains most of the increase in tonnage of ore treated compared with 1940. Production of copper ore and of dry and siliceous ore each increased 11 percent. Cessation in 1940 of old-tailings cyanidation by the Bradshaw Syndicate, Inc., in the Goldfield district,

Esmeralda County, and the Caliente Cyaniding Co. in the Ferguson district, Lincoln County, terminated the large-scale working of old tailings in the State; the quantity of old tailings treated declined 98 percent in 1941 compared with 1940.

The connected-bucket dredge of the Manhattan Gold Dredging Co. in the Manhattan district, Nye County, was again the largest producer of placer gold and the fourth-largest of total gold in the State; the dragline operation started January 1, 1941, by the Dayton Dredging Co. made the second-largest placer-gold and the ninth-largest total-gold output in the State in 1941. In addition to these large placer operators, 2 dragline dredges, 6 nonfloating washing plants with mechanical excavators, 1 hydraulic mine, 52 (24 dry) small-scale hand-method mines, and 15 drift mines were in operation. Quicksilver consumption at placer mines was 405 pounds in 1941.

ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1941 shows that 78 percent of the tonnage of ore (including old tailings) sold or treated was copper ore, 14 percent gold ore and old tailings, 5 percent gold-silver ore and old tailings, nearly 2 percent zinc-lead ore, 1 percent silver ore and old tailings, and the remainder lead ore and old tailings and zinc ore.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Nevada in 1941, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	1,248,162	2,445	205,453	518,177	101,400	67,400	
Dry and siliceous gold-silver ore	413,380	3,601	50,693	2,424,067	83,100	1,202,500	
Dry and siliceous silver ore	112,808	3,527	5,002	1,242,532	32,000	203,500	
	1,774,350	9,573	261,148	4,184,776	216,500	1,473,400	
Copper ore	6,850,444		65,510	259,686	156,649,800	4,300	
Lead ore	26,758	80	964	681,146	915,800	4,592,800	
Zinc ore	1,488					51,900	864,400
Zinc-lead ore	136,942		1,884	690,597	39,900	13,123,600	29,393,600
Total, lode mines	8,789,982	9,653	329,506	5,816,205	157,822,000	19,246,000	30,258,000
Total, placers			36,897	14,033			
	8,789,982	9,653	366,403	5,830,238	157,822,000	19,246,000	30,258,000
Total, 1940	7,890,476	447,783	383,933	5,175,928	156,908,000	14,998,000	23,666,000

METALLURGIC INDUSTRY

Of the 8,799,635 tons of lode material from Nevada sold or treated during 1941, 80 percent went to concentrating mills, 18 percent to amalgamation and cyanidation mills, and 2 percent to smelters; of the total, only 0.1 percent was old tailings—all amalgamated, cyanided, or smelted. Flotation was employed at concentration mills to the virtual exclusion of gravity concentration. Of the gold recovered as

bullion, cyanidation supplied 88 percent and amalgamation 12 percent; of the silver recovered as bullion, 99 percent was derived by cyanidation and 1 percent by amalgamation. The total quantity of crude ore shipped to smelters in 1941 was virtually unchanged from 1940. The Combined Metals Reduction Co., Pioche district, Lincoln County, began to operate its 600-ton selective-flotation mill in September 1941; the mill was laid out so that capacity could be tripled by the addition of two more grinding and flotation units. Operation of the new 150-ton flotation mill built by the West Coast Mines Co., Inc., in the Barrett Springs district, Humboldt County, was begun February 1. Construction of a 350-ton flotation mill by the International Smelting & Refining Co. in the Battle Mountain district, Lander County, neared completion at the end of 1941. Fire destroyed the Black Mammoth 150-ton cyanide mill in the Silver Peak district, Esmeralda County, September 23, 1941.

Quicksilver consumption in Nevada in 1941 at mills using amalgamation was 2,490 pounds in recovering 25,757 ounces of gold and 19,120 ounces of silver from 250,702 tons of material treated.

Data obtained on cyanide consumption in 1941 at Nevada mills are nearly complete. In the treatment of 1,202,361 tons of ore, 1,500 tons of old tailings, and 344 tons of concentrates, 290,182 pounds of 91-percent sodium cyanide and 1,782,513 pounds of commercial-grade calcium cyanide (50-percent NaCN equivalent) were used, with a recovery of 166,936 ounces of gold and 1,841,537 ounces of silver; in terms of 98-percent NaCN the consumption was 1,178,900 pounds, or 0.98 pound to the ton of material treated compared with 0.74 pound in 1940 and 0.64 pound in 1939. The declining proportion of old tailings treated explains the rising average consumption of cyanide in the State.

Mine production of metals in Nevada in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	250,702	25,757	19,120			
Ore, old tailings, sands, slimes, and concentrates cyanided	1,425,740	185,170	2,236,009			
Concentrates smelted:						
Flotation	325,813	76,566	1,602,597	147,146,900	14,424,700	29,270,000
Gravity	267	1,076	17,439	22,300	38,900	
Ore and old tailings smelted	201,669	40,937	1,941,040	10,652,800	4,782,400	988,000
Total, lode mines		329,506	5,816,205	157,822,000	19,246,000	30,258,000
Total, placers		36,897	14,033			
		366,403	5,830,238	157,822,000	19,246,000	30,258,000
Total, 1940		383,933	5,175,928	156,908,000	14,998,000	23,666,000

Custom mills were operated in various parts of Nevada during 1941; all used the cyanide process. Those of importance were at Silver City, Lyon County; Westgate, Churchill County; Gold Point, Esmeralda County; Adelaide, Humboldt County; and Kincaid, Mineral County. Most of the custom mills obtained part of their mill feed from mines controlled by the mill operators. Large quantities of ore and concentrates were shipped out of the State, principally to lead and copper smelters in the Salt Lake Basin. The

Bauer (Utah) plant of the Combined Metals Reduction Co. treated all the company zinc-lead ore mined at Pioche, Lincoln County, until September, when the new Pioche mill was put into operation; the Pioche mill treated ore from its neighbor, the Black Prince mine, upon a custom basis. The McGill copper smelter at McGill in White Pine County, operated by the Nevada Consolidated Copper Corporation, continued in 1941 to be the only smelter and the most important metallurgical plant in the State; the concentrator (daily capacity increased in 1941 from 18,000 to 20,000 tons), operated by the same company, was the largest mill in the State. The Consolidated Coppermines Corporation shipped its copper ore to the McGill concentrator for treatment.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1941, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Churchill	2,856		1,085	886	14	121	309		
Clark	24,018		1,084	1,592	298	3,057	44,088	200	
Douglas	10		14	1					
Elko	393		108	102	1	1	35		
Esmeralda	92,233		2,274	920	37	473	266		
Humboldt	15,665		3,141	1,545	1	1	1		
Lander	1,781	60	577	117					
Lyon	13,885		5,322	589	37	173	51	800	
Mineral	271		88	121	1	2	2		
Nye	12,417	7	4,371	6,686	1	4	2		
Pershing	4,833		2,611	2,415					
Storey	80,996	300	4,201	3,838					
Washoe	970		861	304					
White Pine	7		20	4					
	250,335	367	25,757	19,120	390	3,832	44,754	1,000	
Total, 1940	117,770	3,240	23,131	24,741	662	4,903	98,674	2,300	4,500

CYANIDATION MILLS

County	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Churchill	34,476		8,042	435,467	7	77	914		
Clark	71,098	18	9,206	236,118	31	490	9,247		
Douglas	1		1	3					
Elko	2,904		1,435	18,532	2	3	11		
Esmeralda	183,198		27,361	772,612					
Humboldt	457,587	300	66,014	119,676					
Lander	15,392		2,655	6,258					
Lyon	16,323		622	38,492					
Mineral	2,262	75	1,047	7,288					
Nye	104,844	1,500	15,772	39,306	2	31	17		
Pershing	249,044		14,846	25,355					
Storey	283,291	268	37,754	530,501					
Washoe	159		413	206					
White Pine		3,000	2	6,195					
	1,420,579	5,161	185,170	2,236,009	42	601	10,189		
Total, 1940	1,291,718	438,728	200,913	2,101,800	638	1,514	11,080	1,000	1,100
Grand total:									
1941	1,670,914	5,528	210,927	2,255,129	432	4,433	54,943	1,000	
1940	1,409,488	441,968	224,044	2,126,541	1,300	6,417	109,754	3,300	5,600

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from concentrating mills in Nevada in 1941, in terms of recovered metals

BY COUNTIES

	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	22,427	250	967	62,325	2,300	92,400	
Elko	123,637	30,996	650	113,511	12,779,000	859,900	480,000
Eureka	27	16		33		7,100	8,000
Humboldt	39,598	7,882	5,314	453,508	60,500	978,100	
Lander	2,600	371	162	12,657	24,400	18,100	
Lincoln	129,844	47,913	1,885	600,107	23,800	12,212,100	28,782,000
Mineral	1,326	88	3	27,796	2,200	72,000	
Nye	12,333	614	10	85,293	8,100	220,600	
Pershing	50	3		194	200		
White Pine	6,710,255	237,515	64,218	209,669	134,267,700	3,300	
	7,042,097	325,648	73,209	1,565,093	147,168,200	14,463,600	29,270,000
Total, 1940	6,293,384	316,788	64,341	1,051,015	143,515,600	11,731,200	22,468,000

BY CLASSES OF CONCENTRATES

	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
Dry gold	149	43	3,522	22,100	100	
Dry gold-silver	9,166	1,941	85,168	26,700	208,400	
Dry silver	1	1	219			
Copper	267,261	64,582	229,314	147,032,400	2,200	
Lead	20,058	6,428	1,139,407	82,400	13,573,100	
Zinc	29,013	214	107,463	4,600	679,800	29,270,000
	325,648	73,209	1,565,093	147,168,200	14,463,600	29,270,000

Gross metal content of concentrates produced from ores mined in Nevada in 1941, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	580	4,475	58,430	24,585	283	
Dry gold-silver	9,167	1,942	85,203	28,489	333,702	
Dry silver	1	1	219			
Copper	267,261	64,582	229,314	150,578,106	3,035	
Lead	20,058	6,428	1,139,407	100,325	14,139,109	1,728,673
Zinc	29,013	214	107,463	5,745	717,779	32,529,934
	326,080	77,642	1,620,036	150,737,250	15,193,908	34,258,607
Total, 1940	318,088	70,758	1,160,769	147,614,150	12,392,556	26,834,322

Mine production of metals from Nevada concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	21	198	1,223			
Clark	579	4,514	115,660	2,500	92,400	
Elko	30,999	654	113,557	12,779,000	859,900	480,000
Esmeralda	37	473	266			
Eureka	16		33		7,100	8,000
Humboldt	7,883	5,315	453,509	60,500	978,100	
Lander	371	162	12,657	24,400	18,100	
Lincoln	47,913	1,885	600,107	23,800	12,212,100	28,782,000
Lyon	37	173	51	800		
Mineral	89	5	27,798	2,200	72,000	
Nye	617	45	85,312	8,100	220,600	
Pershing	3		194	200		
White Pine	237,515	64,218	209,669	134,267,700	3,300	
	326,080	77,642	1,620,036	147,169,200	14,463,600	29,270,000
Total, 1940	318,088	70,758	1,160,769	143,518,900	11,736,800	22,468,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	580	4,475	58,430	23,100	100	
Dry gold-silver	9,167	1,942	85,203	26,700	208,400	
Dry silver	1	1	219			
Copper	267,261	64,582	229,314	147,032,400	2,200	
Lead	20,058	6,428	1,139,407	82,400	13,573,100	
Zinc	29,013	214	107,463	4,600	679,800	29,270,000
	326,080	77,642	1,620,036	147,169,200	14,463,600	29,270,000

Gross metal content of Nevada crude ore and old tailings shipped to smelters in 1941, by classes of material

Class of material	Material shipped		Gross metal content				
	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	34,608	38	26,229	72,901	106,183	84,443	
Dry and siliceous gold-silver	80,508	3,480	11,546	810,867	21,737	239,068	
Dry and siliceous silver	29,482	527	1,211	432,870	9,766	137,491	
Copper	24,879		991	30,768	9,917,835	7,067	
Lead	26,319	80	960	593,634	1,041,227	4,649,648	135
Zinc	1,488					73,588	1,054,726
Zinc-lead	260					76,151	154,408
	197,544	4,125	40,937	1,941,040	11,096,748	5,267,456	1,209,269
Total, 1940	197,438	5,565	51,219	1,875,596	13,909,373	3,697,184	1,613,295

Mine production of metals from Nevada crude ore and old tailings shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	96	15	261	5,743			
Clark	3,811		2,951	23,716	1,500	187,600	860,000
Elko	24,168		1,972	66,986	9,041,000	488,100	
Esmeralda	4,317	41	4,285	20,213	2,000	22,000	
Eureka	6,676		2,878	41,575	4,000	42,900	
Humboldt	2,960		1,309	22,558	9,500	23,900	
Lander	11,775		2,599	75,835	515,600	149,900	
Lincoln	51,940	110	3,866	651,696	902,200	3,345,900	
Lyon	346		50	406	61,200		
Mineral	2,497		1,048	32,753	3,800	172,000	
Nye	17,354	450	5,879	463,582	3,900	165,400	
Pershing	1,615		1,105	31,765	9,800	90,000	
Storey	158		1,020	4,671			
Washoe	244		196	6,960	12,000	6,000	
White Pine	69,587	3,509	11,518	492,581	86,300	88,700	128,000
	197,544	4,125	40,937	1,941,040	10,652,800	4,782,400	988,000
Total, 1940	197,438	5,565	51,219	1,875,596	13,389,100	3,261,200	1,198,000

BY CLASSES OF MATERIAL

	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	34,608	38	26,229	72,901	99,800	59,800	
Dry and siliceous gold-silver	80.508	3,480	11,546	810,867	18,900	193,700	
Dry and siliceous silver	29,482	527	1,211	432,870	7,300	101,300	
Copper	24,879		991	30,768	9,619,200	4,300	
Lead	26,319	80	960	593,634	907,600	4,318,000	
Zinc	1,488					51,900	864,400
Zinc-lead	260					53,400	123,600
	197,544	4,125	40,937	1,941,040	10,652,800	4,782,400	988,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1941, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Churchill County:											
Alpine	1		50	23		23	10				$812
Broken Hills	2		1,087	9		9	15,092				11,047
Desert	1		47	2		2	3				73
Dixie Valley	2		2,747	1,814		1,814	2,233				65,078
Eastgate	4		1,872	511		511	5,348				21,688
Fairview	2		4,041	581		581	46,436				53,356
Fireball	2		34	7		7	7				250
Holy Cross	1		92	14		14	5,179				4,173
I X L	1		1	1		1					35
Sand Springs	6		20,688	5,765		5,765	298,499				414,041
Wonder	6		5,127	859		859	70,512				80,207
Clark County:											
Crescent	3		136	89		89	232		700		3,320
Eldorado Canyon	9		103,837	11,956		11,956	367,802	800	5,400		680,410
Gold Butte	1		2,850	36		36	14				1,270
Searchlight	20		4,092	3,908		3,908	4,524	2,100	5,000		140,530
Sunset	1		40	15		15	4				528
Yellow Pine	15		10,073	1,751		1,751	4,510	1,100	268,900	860,000	144,449
Douglas County:											
Mount Siegel		1			11	11					385
Silver Glance	2		11	15		15	4				528
Elko County:											
Centennial	2		750	330		330	900		9,200		12,714
Contact	4		112	2		2	253	13,500			1,843
Cope	10	2	132,784	538	2,128	2,666	41,244	21,511,600	8,900		2,661,515
Delano	6		1,433	11		11	29,205	8,300	346,000		41,854
Dolly Varden	1		1,510	2		2	232	187,500			22,360
Ferber	1		30	1		1	83	2,700			413
Gold Circle	8	1	2,857	1,452	1	1,453	21,493	300			66,174
Island Mountain	1	1	3	7	145	152	48				5,354
Ivanhoe	1		46	8		8	21				295
Jarbidge	7		459	347		347	782				12,701
Lime Mountain	1		2,960	1,247		1,247	3,375	70,800			54,399
Mardis	1		62	186		186	121	500			6,655
Merrimac	3		7,432	31		31	91,152	16,100	852,300	480,000	152,385
Mud Springs	2		13				90		1,800		167
Rock Creek	1		1				246				175

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Elko County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Spruce Mountain	2		581	3		3	8,744	8,600	123,000		$14,349
Tecoma	1		4				111				79
Tuscarora	2	1	64	4	2	6	1,769	100	5,800		1,811
Warm Creek	1		1				38		1,000		84
Esmeralda County.											
Desert	8		181	216		216	436				7,870
Divide	5		684	412		412	6,293				18,895
Dyer	1		18	14		14	14				500
Goldfield	7		3,019	3,288		3,288	1,807	2,000	400		116,624
Hornsilver	18		12,331	3,608		3,608	29,080		2,200		147,084
Klondyke	3		91	42		42	4,541		12,400		5,406
Lida	1	1	4	6	15	21	17				747
Lone Mountain	1		6	1		1	28				55
Montezuma	1		111	1		1	2,101		400		1,552
Oneota	1		775	106		106	73				3,762
Palmetto	1		47	16		16	56				600
Silver Peak	17		170,359	26,675		26,675	748,973		6,600		1,466,604
Sylvania		2			3	3					105
Tonopah [4]	1		41	8		8	595				703
Eureka County:											
Buckhorn	1		1,180	329		329	3,347				13,895
Cortez	5		1,389	839		839	9,145	2,000	19,600	8,000	37,821
Eureka	22	11	3,931	1,663	411	2,074	23,915		21,600		90,827
Mount Hope	1		8				4	1,000			121
Safford	3		195	47		47	5,224	1,000	8,800		5,980
Humboldt County:											
Awakening	6		11,291	1,305		1,305	1,021	900			46,507
Barrett Springs	10		40,900	6,291		6,291	469,551	67,000	999,800		618,983
Battle Mountain [5]		1			390	390	52				13,687
Central [6]	1		91	9		9	45		400		370
Donnelly	1		54	47		47	65				1,691
Florence	1		29	9		9	1,228		1,200		1,256
Gold Run	8	3	100,739	6,596	50	6,646	117,371				316,074
Iron Point	1		98				1,282		300		929
Leonard Creek		2			16	16	3				562
National	2		744	755		755	3,026		100		28,583
Paradise Valley	4		48	432		432	491				15,469

Sawtooth [6]		(7)			13	13	3				457
Sulphur		(7)			43	43	15				1,516
Varyville	2		323	57		57	153	1,500	200		2,292
Warm Springs	5	1	3,575	817	9	826	193	600			29,118
Lander County:											
Battle Mountain [6]	19	3	11,691	2,380	154	2,534	57,223	456,100	142,000		191,296
Bullion	12	3	10,249	1,476	499	1,975	23,134	81,300	19,000		96,252
Hilltop	3		352	213		213	2,665	2,600	7,000		10,056
Kingston	2		92	16		16	100				631
McCoy	1		7,000	931		931	5,237				36,309
New Pass	3		2,154	970		970	803				34,521
Reese River	2		25				2,372				1,687
Lincoln County:											
Chief	1		93	85		85	1,080		1,100		3,806
Comet	1		911	98		98	3,510	400	8,400		6,452
Eagle Valley	2		70	44		44	270				1,732
Ferguson	4		1,063	1,554		1,554	2,807	1,000	3,800		56,721
Jack Rabbit	3		18,663	179		179	305,799	887,000	1,880,900		435,599
Pahranagat	7		284	14		14	6,300	2,000	16,900		6,169
Pennsylvania	2		301	163		163	2,025	1,400			7,310
Pioche	15		160,505	3,614		3,614	929,884	34,200	13,644,900	28,782,000	3,728,186
Tempiute	1		4				128		2,000		205
Lyon County:											
Buckskin	1	1	222	80	10	90	107				3,226
Cambridge	1		3	1		1					35
Palmyra	7		7,454	994		994	16,854				46,775
Pine Grove	4		7,257	300		300	101	800			10,666
Silver City	24	3	19,761	3,771	10,579	14,350	16,068				513,676
Yerington	8		381	27		27	114	61,200			8,248
Mineral County.											
Aurora	8	(7)	236	240	3	243	2,191				10,063
Bell	2		270	154		154	187				5,523
Columbus	4		1,805	501		501	20,205	800	142,700		40,131
East Walker	6		648	170		170	249				6,127
Garfield	1		224	69		69	2,267				4,027
Hawthorne	10	1	2,000	425	4	429	28,125	2,200	72,000		39,379
Marietta	5		131	31		31	2,707	400	7,300		3,473
Pilot Mountains	3		37	8		8	28	1,100			430
Rand	3		42	12		12	121				506
Regent	7	1	182	93	35	128	897	300	200		5,164
Santa Fe	5		568	247		247	2,652	100	7,400		10,965
Silver Star	9		288	238		238	8,359	1,100	14,400		15,225
Nye County:											
Athens	1		688	465		465	270				16,467
Bellehelen	2		552	123		123	3,392				6,717
Belmont	4		515	6		6	7,138				5,286
Bullfrog	16		2,571	735		735	1,281	100			26,648
Cactus Range	1		3	1		1	14				45

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Nye County—Continued											
Carrara	1		3				104				$74
Cloverdale	2	1	79	18	2	20	495				1,052
Currant Creek	2		168	47		47	38				1,672
Eden	1		10	1		1					35
Ellendale	1		92	22		22	21				785
Fairplay	3		209	46		46	1,620				2,762
Flourine	1		29				415				295
Golden Arrow	3		694	264		264	8,290				15,135
Gold Reed	2		33	6		6	374				476
Hannapah	2		19	2		2	685				557
Jackson	6		213	113		113	537				4,337
Jefferson Canyon	1		1				28				20
Johnnie	1	1	90	13	8	21					735
Mammoth	3		333	43		43	4,597				4,774
Manhattan	21	8	4,480	3,106	21,034	24,140	9,079	200			851,380
Millett	4		118	99		99	2,527				5,262
Morey	2		784	48		48	12,828		500		10,831
Northumberland	1		97,177	12,737		12,737	9,024				452,212
Phonolite	1		5,000	1,506		1,506	18,079				65,566
Quartz Mountain	2		420	47		47	6,882	2,900	120,300		13,738
Reveille	3		44	1		1	987				737
Round Mountain	5		7,376	1,888		1,888	5,486				69,981
San Antone	1		44	50		50	114				1,831
Silver Bow	3		662	96		96	12,880				12,519
Tonopah [4]	7		11,202	4,113		4,113	376,939	400	5,000		412,333
Troy	1		606	191		191	38				6,712
Tybo	8		2,223	166		166	30,475	300	39,600		29,773
Union	7	1	12,426	105	1	106	87,244	8,100	220,600		79,280
Willow Creek	1		41	9		9	28				335
Pershing County											
Antelope	3	2	580	260	125	385	194				13,613
Central [6]	3		517	32		32	19,045	1,800	54,400		17,976
Haystack	1		141	56		56	24				1,977
Imlay	2	8	246,233	14,557	215	14,772	15,061				527,730
Kennedy	9		536	254		254	5,123	7,900	4,900		13,744
Placerites		(7)			37	37	3				1,297
Rochester	9	6	1,094	273	108	381	10,620				20,887
Rosebud	1	2	2,000	329	673	1,002	1,270				35,973
Sawtooth [6]		1			17	17	3				597

Seven Troughs	15		2,938	1,935		1,935	1,742				68,964
Sierra	7		712	270		270	475	100	200		9,811
Staggs	1	1	524	530	2	532	6,151		30,400		24,727
Star	1		50				194	200			162
Trinity		([7])			12	12	4				423
Unionville		2			15	15	3				527
Washiki	1		216	65		65	35		100		2,306
Storey County: Comstock	46	1	331,502	42,975	6	42,981	539,058				1,887,665
Washoe County:											
Galena	1		16				634	200			475
Granite Range	1		41	2		2	1,506		5,400		1,449
Jumbo	1		13	5		5	4				178
Peavine	1		143	29		29	4,226	5,900	600		4,750
Pyramid	1		38	3		3	336	5,900			1,040
Stateline Peak	3		61	20		20	93				766
White Horse	12	([7])	1,061	1,411	27	1,438	679				50,813
White Pine County:											
Aurum	3		508	4		4	1,422	2,400	35,600	128,000	13,063
Bald Mountain	1		326	62		62	689	7,500			3,545
Cherry Creek	18		9,796	1,199		1,199	80,872	100	500		99,515
Duck Creek	7		38				287	600	25,900		1,751
Eagle	2		49	2		2	844	100	20,900		1,873
Granite	3		233	76		76	758				3,199
Newark	3		906	8		8	6,571		5,500		5,267
Osceola	7	5	6,089	5,758	94	5,852	2,092				206,308
Piermont	1		564	27		27	10,654				8,521
Robinson	31		6,745,600	68,057		68,057	374,337	134,342,900			18,500,652
Shoshone	1		1				5		300		21
Taylor	6		14,244	418		418	199,900				156,781
Ward	6		4,897	143		143	23,339				21,602
White Pine	6		3,091	4		4	6,483		3,300		4,938
Other districts [8]	7		360,817	60,463		60,463	18,560	400			2,129,450
Total Nevada	799	78	8,799,635	329,506	36,897	366,403	5,830,238	157,822,000	19,246,000	30,258,000	38,959,420

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures, other producing districts listed in footnote 8 and their output included under "Other districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of total silver as follows: 5,816,205 ounces from lode mines and 14,033 ounces from placers
[4] Tonopah district lies in both Esmeralda and Nye Counties.
[5] Battle Mountain district lies in both Humboldt and Lander Counties.
[6] Central and Sawtooth districts lie in both Humboldt and Pershing Counties.
[7] Output from property not classed as a "mine."
[8] Includes following districts. Potosi in Humboldt County, Lewis in Lander County; Talapoosa in Lyon County; Echo in Pershing County; and Kinsley in White Pine County.

CHURCHILL COUNTY

The Westgate Mining & Milling Corporation, operator of a custom cyanide mill at Westgate, was reorganized in 1941 as the Silver State Milling Corporation. This plant treated 9,170 tons of ore from 40 shippers and continued to be an important factor in the mining industry of Churchill County.

Dixie Valley district.—The Comstock-Keystone Mining Co. operated the Dixie mine from January 1 to March 31, 1941, when it was leased to Dale & Hargrove who continued operations until the end of the year. A total of 2,731 tons of ore was treated in a 20-ton amalgamation mill, followed by table concentration and cyanide leaching of the sands; the amalgamation bullion contained 1,050 ounces of gold and 865 ounces of silver, cyanidation precipitates contained 439 ounces of gold and 621 ounces of silver, and 14 tons of concentrates shipped to a smelter contained 121 ounces of gold and 309 ounces of silver. In addition, 1 ton (1,767 pounds) of high-grade ore shipped to a smelter yielded 204 ounces of gold and 384 ounces of silver.

Eastgate district.—Schweiss & Luce shipped gold ore from the Gold Ledge mine to a custom cyanide mill in 1941.

Fairview district.—Several groups of lessees worked the Nevada Hills mine and produced 4,029 tons of gold-silver ore; 3,953 tons shipped to custom cyanide plants yielded 531 ounces of gold and 42,957 ounces of silver, and 76 tons of ore shipped to a smelter contained 50 ounces of gold, 3,253 ounces of silver, and 130 pounds of copper.

Holy Cross district.—Several groups of lessees on the Pyramid group shipped ore to a custom cyanide mill in 1941.

Sand Springs district.—Summit King Mines, Ltd., operated the Dan Tucker mine throughout 1941 and treated the ore in the company 65-ton all-slime cyanide plant. The Dan Tucker Extension Mining Co. shipped 155 tons of ore, yielding 13 ounces of gold and 4,212 ounces of silver, from the Double Ender mine to a custom cyanide mill; operations were suspended, and the lease was relinquished during the year.

Wonder district.—Lessees shipped gold-silver ore from the Giger mine to custom cyanide mills during 1941. Lessees operated the Jack Pot and Grand View mines. Several groups of lessees worked the Nevada Wonder mine. A. W. Schulze shipped silver ore from the Queen-Vulture mine to a custom cyanide mill.

CLARK COUNTY

Eldorado Canyon district.—The El Dorado-Rover Mining Co. operated the Quaker City, Magnolia, Crown, and Nevada Eagle groups of claims throughout 1941. Gold-silver ore was shipped to a smelter from the Occidental mine. Silver ore shipped to a smelter from the Oro Plata (Belmont Phoenix) mine contained 66 ounces of gold, 16,243 ounces of silver, 217 pounds of copper, and 901 pounds of lead. The Diamond Gold Mining Co. operated the Techatticup, Jubilee, and Red Butte mines throughout 1941; the ore was treated in a 100-ton flotation mill during the early months of the year but after July in a new 200-ton cyanide mill. W. W. Hartman operated the Wall Street mine.

Searchlight district.—Lessees operated the Blossom mine during 1941. H. H. Lang worked the Good Hope mine. W. H. Kelsey operated the M & M property. The Monte Carlo group was active. F. P. Jackson shipped ore from the Valley mine to a custom mill and a smelter.

Yellow Pine (Goodsprings) district.—H. V. Jarman shipped lead and zinc-lead ores from the Addison mine in 1941. The Chiquita Mining Co., Ltd., operated the Chiquita mine. O. F. Schwartz (Barefoot Lease) operated the Golden Chariot mine; 367 tons of ore treated by amalgamation yielded 27 ounces of gold and 4 ounces of silver, and 10 tons of flotation concentrates shipped to a smelter contained 23 ounces of gold, 1 ounce of silver, and 170 pounds of copper; in addition, 36 tons of ore containing 83 ounces of gold, 12 ounces of silver, and 692 pounds of copper were shipped to a smelter. O. F. Schwartz also operated the Hoosier and Keystone-Barefoot mines. F. Williams shipped 57 tons of zinc ore containing 4,053 pounds of lead and 33,618 pounds of zinc from the Hoodoo Nos. 1 and 2. Gressman & Flukey shipped 60 tons of zinc ore containing 7,794 pounds of lead and 32,358 pounds of zinc from the Milford No. 1 mine. From the Milford No. 2 T. J. Hammons and R. H. Reed shipped 8 tons of lead ore, containing 35 ounces of silver and 11,507 pounds of lead, and 179 tons of zinc-lead ore, containing 59,262 pounds of lead and 100,961 pounds of zinc. Jacobson, Krider, and Reim, lessees on the Sultan mine, shipped 414 tons of lead ore to a custom flotation mill and 61 tons of zinc ore to a smelter; the 60 tons of resulting concentrates contained 1 ounce of gold, 2,163 ounces of silver, 119 pounds of copper, and 61,378 pounds of lead, and the 61 tons of zinc ore contained 4,929 pounds of lead and 51,469 pounds of zinc. From the Tam O'Shanter mine Jacobson and Krider shipped to a smelter 266 tons of lead ore containing 1,736 ounces of silver, 205 pounds of copper, and 41,776 pounds of lead. The Yellow Pine Lease operated the Yellow Pine mine throughout 1941 and shipped zinc ore to a smelter.

ELKO COUNTY

Cope (Mountain City) district.—The Mountain City Copper Co. (third-largest copper producer in Nevada) was active throughout 1941; part of the ore was treated in the company 400-ton flotation mill, and high-grade ore was shipped for direct smelting. The Morrison-Knudsen Co., Inc., operated a dragline dredge, using a dragline excavator with a 2-cubic yard bucket, at the Van Duzer mine on Van Duzer Creek from April 1 to December 20.

Delano district.—Lessees on the Cleveland mine shipped 233 tons of lead ore containing 2 ounces of gold, 6,377 ounces of silver, 1,759 pounds of copper, and 87,909 pounds of lead during 1941. Lessees on the Net Group shipped to a smelter 1,145 tons of lead ore containing 8 ounces of gold, 21,915 ounces of silver, 6,889 pounds of copper, and 361,418 pounds of lead.

Dolly Varden district.—E. G. Gibson shipped copper ore from the Victoria mine to a smelter in 1941.

Gold Circle district.—Gold & Silver Circle Mines, Inc., was the largest producer of gold and silver in the district in 1941. Esmeralda Gold Mines, Ltd., operated the Esmeralda mine and treated gold ore by cyanidation. W. Collins worked the Miner's Gold mine.

Lime Mountain district.—Lime Mountain Consolidated operated the Lime Mountain mine throughout 1941; 2,960 tons of ore shipped to a smelter contained 1,247 ounces of gold, 3,375 ounces of silver, and 72,880 pounds of copper.

Mardis district.—From the Virginia mine in 1941 J. M. Prunty shipped to a smelter 62 tons of ore containing 186 ounces of gold, 121 ounces of silver, and 700 pounds of copper.

Merrimac (Lone Mountain) district.—The Rip Van Winkle Consolidated Mining Co. treated 7,376 tons of zinc-lead ore in the company 100-ton flotation mill and shipped to a smelter 691 tons of lead concentrates (containing 13 ounces of gold, 88,295 ounces of silver, 13,519 pounds of copper, and 883,312 pounds of lead) and 554 tons of zinc concentrates (containing 3 ounces of gold, 2,827 ounces of silver, 5,745 pounds of copper, 5,760 pounds of lead, and 539,779 pounds of zinc).

Spruce Mountain (Black Forest) district.—The Missouri Monarch Consolidated Mines Co. operated the Missouri Monarch mine from January 1 to October 31, 1941, when the property was leased to L. M. Conley who continued operations until the end of the year; silver ore, copper ore, and lead ore were shipped to a smelter.

ESMERALDA COUNTY

Divide district.—Several groups of lessees on the Tonopah Divide mine shipped 632 tons of gold ore containing 376 ounces of gold and 5,887 ounces of silver to a smelter during 1941.

Goldfield district.—The Diamondfield Daisy Gold Mining Co. shipped gold ore from the Diamond Daisy mine to a smelter in 1941. Several groups of lessees worked the Black Butte, Florence, and Merger claims of the Goldfield Deep Mines Co. of Nevada. The Goldfield Consolidated Mines Co. property was operated by several groups of lessees.

Hornsilver (Gold Point) district.—The Ohio Mines Corporation operated the Ohio group throughout 1941; in addition to company ore, over 2,400 tons of custom material received from 37 shippers was treated in the company 50-ton cyanide mill. The Orleans mine, one of the Ohio group, was operated as the Midnight Lease. Several groups of lessees on the Tokop mine shipped ore to a custom cyanide mill.

Klondyke district.—The Original Klondyke Divide Mining Co. shipped lead ore from the Original Klondyke mine to a smelter in 1941.

Oneota district.—The Red Top Mining Co. constructed a cyanide mill at the Brownie mine in 1941, which was operated for a short period during the year.

Silver Peak district.—In 1941 Desert Silver, Inc., worked the Nivloc mine, leading silver producer in the State since 1938. The Silver Divide Mines Co. operated the Coyette mine from August to December 1941. E. L. Cord, operating as the Prescott Lease, worked the Mary mine throughout the year; ore was treated in the company 350-ton flotation-amalgamation-cyanide mill. Lessees shipped gold ore from the Oromonte mine to a custom cyanide mill and to a smelter. The Silver Peak Custom Milling Co. operated the Black Mammoth mill as a custom plant for a short period in 1941 before it was destroyed by fire September 23.

EUREKA COUNTY

Buckhorn district.—Between March 1 and December 15, 1941, D. P. Murphy shipped ore from the Buckhorn mine dumps to a smelter.

Cortez district.—Lessees shipped silver ore from the Cortez mine to a smelter during 1941. The Ventura mine was active throughout the year; 864 tons of ore containing 760 ounces of gold, 623 ounces of silver, and 524 pounds of copper were shipped to a smelter.

Eureka district.—A lessee operated the Colorado mine and shipped gold ore to a smelter in 1941. The Eureka Prospect Co. worked the Diamond Excelsior mine intermittently. Lessees worked the Eureka Croesus mine. The Eureka Corporation, Ltd., shipped ore from several properties in the Eureka district; the largest production came from the Oswego property in the Secret Canyon section.

HUMBOLDT COUNTY

Awakening (Slumbering Hills) district.—Austin Bros. Gold Mining Co. operated the Jumbo group from May 11 to October 18, 1941.

Barrett Springs (Ten-mile) district.—West Coast Mines, Inc., began operation of its new 150-ton flotation mill at the Pansy Lee mine February 1, 1941; 39,598 tons of ore milled yielded 7,882 tons of concentrates containing 5,314 ounces of gold, 453,508 ounces of silver, 71,130 pounds of copper, and 1,018,842 pounds of lead; and 407 tons of ore shipped to a smelter contained 157 ounces of gold, 13,217 ounces of silver, 2,929 pounds of copper, and 30,894 pounds of lead. This mine was the third-largest producer of silver in the State in 1941. King Gold Mines in the Ten-mile section of the Barrett Springs district was active during 1941.

Battle Mountain district.—The B. & M. Mining Co. operated a nonfloating washing plant at the Johnny Boy placer group from June 12 to November 24, 1941. Gravel was delivered to the plant by a dragline excavator using a 1½-cubic yard bucket.

Gold Run (Adelaide) district.—Adelaide Crown Mines operated the Adelaide Crown mine throughout 1941; 96,898 tons of ore treated in the company 300-ton all-slime cyanide mill yielded 5,249 ounces of gold and 113,705 ounces of silver; the company also treated 2,287 tons of custom ore from 18 shippers. Marigold Mines, Inc., worked the Marigold mine and shipped ore to custom cyanide mills and to a smelter.

National district.—A lessee operated the Buckskin mine from April 1 to December 31, 1941; 639 tons of ore shipped to custom cyanide mills contained 453 ounces of gold and 2,210 ounces of silver, and 103 tons of ore shipped to a smelter contained 110 ounces of gold, 589 ounces of silver, 94 pounds of copper, and 157 pounds of lead. Lessees mined 2 tons of very high grade ore at the National mine; in August the mine was leased to the Santa Rosa Mining Co., subject to the leases already in effect.

Potosi district.—Getchell Mine, Inc., operated the Getchell mine throughout 1941 and continued to hold first place in Nevada as a gold producer. Ore was treated in the company 1,000-ton cyanide plant, to which a 260- by 7½-foot rotary kiln was added during the year.

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Warm Springs district.—Gold ore was treated by amalgamation at the Ashdown mine in 1941. The Homer Verne Mining Co. operated the Homer Verne mine in the Boyd Basin section of the Warm Springs district.

LANDER COUNTY

Battle Mountain district.—In 1941, as in former years, lessees at the various small mines in the Battle Mountain district produced much of the ore shipped to smelters. Small mines that were active included the Armour, Bentley, Big Florence, Buffalo Valley, Buzzard, Copper Queen, Eldorado, Gold Butte, Gold Cash, Gold Road, Hard Times, Oriole, Plumas, San Miguel, Trinity, and White. The International Smelting & Refining Co. took a 5-year lease on the property of the Copper Canyon Mining Co. with option to purchase 51 percent of the Copper Canyon Mining Co. stock. The lessee budgeted $500,000 for examination and the construction of a 350-ton flotation mill, building of which was started late in the year. In addition to examination and construction activities, a substantial quantity of copper ore was shipped to a smelter during 1941. Broyles and Wilson, one of the larger lessees in the district, shipped gold-silver ore from the Independence group.

Bullion district.—H. W. Treweek operated a cyanide mill on the Goldacres property during 1941. The Gray Eagle Mining Co. worked the Gray Eagle mine. Lessees operated the Little Gem mine and treated silver ore by flotation; copper ore was shipped to a smelter. Several operators on Triplett Gulch produced 413 ounces of gold and 40 ounces of silver from placer gravels.

McCoy district.—The Nevada United Gold Mining Co. cyanided a substantial quantity of gold ore produced at the Gold Dome mine during 1941.

New Pass district.—New Pass Mines operated the New Pass mine from January 1 to December 22, 1941. W. H. Smith treated 291 tons of ore from the Thomas W. mine and recovered 146 ounces of gold and 23 ounces of silver.

LINCOLN COUNTY

Comet district.—The Comet Mines Co. carried on test runs at the Comet mine during 1941; 565 tons of ore were treated by flotation, and 7 tons of resulting concentrates shipped to a smelter contained 17 ounces of gold, 665 ounces of silver, 90 pounds of copper, and 656 pounds of lead; and 346 tons of ore shipped to a smelter contained 81 ounces of gold, 2,845 ounces of silver, 404 pounds of copper, and 13,405 pounds of lead.

Ferguson (Delamar) district.—During 1941 lessees shipped gold ore to a smelter from the properties owned by the Delamar Exploration Co.

Jack Rabbit (Bristol) district.—The Bristol Silver Mines Co. operated the Bristol Silver mine throughout 1941; 18,576 tons of lead ore containing 178 ounces of gold, 305,232 ounces of silver, 1,002,198 pounds of copper, and 1,975,935 pounds of lead were shipped to a smelter.

Pioche district.—The Combined Metals Reduction Co. (affiliate of the National Lead Co.) worked the Pioche Nos. 1 and 2 mines and a section of the Amalgamated Pioche mine throughout 1941; the company was the largest producer of both lead and zinc in the State.

From January until September all the production was shipped to the company 600-ton selective-flotation mill at Bauer, Utah, but from September until the end of the year virtually all the output was treated in the 600-ton selective-flotation mill erected by the company at Castleton 3 miles southwest of Pioche. In addition to company ore, this new mill handled ore from the Black Prince mine for the Prince Consolidated Mining Co. The Amalgamated Pioche Mines & Smelters Corporation shipped lead ore from a section of the Amalgamated Pioche mine to a smelter in 1941. W. A. Free shipped lead ore from the Apex and the Financier mines to a smelter. The Nevada Volcano Mines Co. operated the Nevada Volcano mine from May 29 to December 31 and shipped lead ore to a smelter. The Hall Bros. Co., Inc., shipped from the Raymond Ely mine to a smelter 27,006 tons of gold-silver ore containing 1,217 ounces of gold and 130,700 ounces of silver. Lessees shipped gold-silver smelting ore from the Wide Awake mine.

LYON COUNTY

Palmyra district.—T. Panos shipped gold ore from the Carpenter mine to a custom cyanide mill. P. Haggerty, a lessee on the Hulley Logan mine, shipped gold-silver ore to a custom cyanide mill. A. Lundgren shipped gold-silver ore from the North Rapidan mine to a custom cyanide mill.

Pine Grove (Wilson) district.—G. L. Felt, a lessee, operated the Wilson mine from February 1 until December 31, 1941, and reconstructed the mill at the property as a 150-ton flotation plant; gold concentrates were shipped to a custom cyanide mill and to a smelter.

Silver City district.—The Dayton Consolidated Mines Co. operated the Dayton mine in 1941 on company account and through lessees. In addition to the Dayton mine ore, the company treated ore it mined at other properties in the Silver City district and more than 20,000 tons of custom ore received from 250 shippers working mines in Silver City and other districts. Gold ore from the Haywood mine was shipped to the Dayton mill. The Gold Rock Mining Co. and lessees operated the Buckeye group; the company reconstructed the mill as a 75-ton amalgamation-flotation plant. A number of lessees working the Oest mine produced 863 tons of ore, from which 284 ounces of gold and 479 ounces of silver were recovered; some of the ore was amalgamated and some shipped to a custom cyanide mill. Lessees operated the Silver City mine. The Dayton Dredging Co. operated a dragline dredge at its property on the north edge of Dayton from January 1 to December 31; the dragline dredge used a dragline excavator with a 14-cubic yard bucket which, when installed, was the largest used in dragline dredging in the world.

Talapoosa district.—F. J. de Longchamps operated the Talapoosa mine from January to July 1941 and shipped ore to the Dayton Consolidated Mining Co. custom mill for treatment.

MINERAL COUNTY

Columbus (Candelaria) district.—Gold-silver ore from the Silver King mine was shipped to a smelter in 1941.

Hawthorne (Pamlico, Ashby) district.—Lessees on the Ashby mine shipped gold ore to custom cyanide mills during 1941. Champion

City Mines, Inc., treated 1,326 tons of silver ore in the company 200-ton flotation mill and shipped to a smelter 88 tons of lead concentrates containing 3 ounces of gold, 27,796 ounces of silver, 3,012 pounds of copper, and 75,020 pounds of lead.

Santa Fe district.—Lessees shipped gold ore from the Clay Peters group to a smelter in 1941.

Silver Star (Gold Range) district.—Lessees on the Lancashire mine shipped gold-silver ore to a custom cyanide mill and lead ore to a smelter in 1941.

NYE COUNTY

Bellehelen district.—Western Gold, Inc., shipped gold-silver ore from the dumps of the Clifford mine to a smelter during 1941.

Belmont district.—Ore and old tailings, valued chiefly for silver, were shipped to a smelter from the Combination mine in 1941.

Bullfrog district.—C. L. Tibbols operated the Denver mine from January 8 to September 2, 1941; 257 tons of ore shipped to custom cyanide mills yielded 149 ounces of gold and 202 ounces of silver. M. F. Hazen operated the May Flower mine from February to November. Lessees operated the Senator Stewart mine from January 11 to March 11.

Golden Arrow district.—Gold-silver ore from the Golden Arrow mine was shipped to a smelter in 1941. Lessees on the Golden Bar mine shipped gold ore to a custom mill and to a smelter.

Manhattan district.—Lessees on the April Fool mine in 1941 produced 328 tons of ore from which 240 ounces of gold and 89 ounces of silver were recovered by amalgamation and cyanidation. The Big Four mine was operated by lessees. J. Francisco operated the Jumbo mine under lease from January to November and treated gold ore in his 35-ton stamp mill located on a nearby property. Lessees worked the Manhattan mine and treated gold ore in a 5-stamp amalgamation mill. Lessees worked the Nevada Coalition mine. The Reliance Mining Co. suspended operations at the Verden mine in June 1941; during the year, a substantial quantity of gold was recovered from clean-up of the mill and high-grade ore shipped to a smelter. The Manhattan Gold Dredging Co. (largest producer of placer gold in the State since 1939) operated throughout 1941 its electric connected-bucket dredge equipped with 108 9½-cubic foot buckets.

Northumberland district.—The Northumberland Mining Co. operated the Northumberland mine throughout 1941.

Phonolite district.—A clean-up at the Penelas mine in 1941 yielded a substantial quantity of gold and silver.

Quartz Mountain district.—O. LeFavor shipped lead ore from the San Rafael mine to a smelter in 1941.

Round Mountain district.—Morrin & Steigmeyer operated the Gold Hill mine during 1941. S. W. Boswick worked for 40 days the Mary McLean mine in the Red Mountain section of the Round Mountain district. J. J. Raymond worked the Monte Christo mine.

Silver Bow district.—In 1941 silver ore from the Catlin and Hillside mines was shipped to a smelter. In addition, some gold-silver ore from the Hillside mine was treated in a custom cyanide mill.

Tonopah district.—Gold-silver ore mined by a lessee at the Jim Butler mine was shipped to a smelter in 1941. Lessees shipped 446 tons of gold-silver ore containing 207 ounces of gold and 18,937 ounces of silver from the Tonopah Belmont mine. Silver ore and mill clean-

up from the Tonopah Extension mine were shipped to a smelter. Several sets of lessees operated the Tonopah Mining Co. of Nevada property throughout 1941 and shipped gold-silver ore to a smelter. Lessees on the West End mine shipped silver ore to a smelter.

Tybo district.—Silver ore from the Ramona mine was shipped to a smelter during 1941. Lessees shipped to a smelter gold-silver ore and lead ore from the Two G mine.

Union district.—Silver Palace Mines, Inc., operated the Silver Palace mine from April until the end of 1941, and 12,233 tons of silver ore were treated in a 50-ton flotation plant built during the year; 613 tons of lead concentrates recovered contained 3 ounces of gold, 85,283 ounces of silver, 12,443 pounds of copper, 230,202 pounds of lead, and 188,411 pounds of zinc. The company planned adding selective flotation to produce a zinc concentrate.

PERSHING COUNTY

Central district.—Jones Bros. & Associates worked the Keystone mine in 1941; 501 tons of lead ore shipped to a smelter contained 21 ounces of gold, 18,904 ounces of silver, 1,924 pounds of copper, and 68,313 pounds of lead.

Imlay district.—The Standard Cyaniding Co. operated the Gold Standard mine throughout 1941. Between April 15 and December 20 J. K. Wadley treated in a 4-ton amalgamation mill 27 tons of ore from a property 20 miles west of Imlay and recovered 317 ounces of gold and 166 ounces of silver.

Rochester district.—E. McCartney shipped gold-silver ore from the West Slope mine to a custom cyanide mill.

Rosebud district.—P. Webster operated the Brown Palace mine from January 1 to October 1, 1941, and treated the ore in a 20-ton cyanide plant. Acme Gold Placers, Inc., operated a nonfloating washing plant on the Acme property.

Seven Troughs district.—Laughton & Causten operated the Portland mine throughout 1941; ore was treated in a 25-ton amalgamation-concentration mill.

Staggs district.—The Twin Buttes Mining Syndicate operated the Twin Buttes mine throughout 1941; 524 tons of ore shipped to a smelter contained 530 ounces of gold, 6,151 ounces of silver, 54 pounds of copper, and 40,573 pounds of lead.

STOREY COUNTY

Comstock district.—Lessees on the Chollar-Potosi mine in 1941 shipped to a custom cyanide mill 1,041 tons of ore from which 370 ounces of gold and 8,476 ounces of silver were recovered. The Consolidated Virginia Mining Co. operated the Consolidated Virginia mine continuously. Sutro Tunnel Coalition, Inc., operated the Crown Point mine throughout the year; the output of gold-silver ore was treated in the company 100-ton cyanide mill. The Dayton Consolidated Mines Co. and lessees shipped 2,131 tons of ore to the Dayton Consolidated cyanide mill in Silver City; 606 ounces of gold and 8,286 ounces of silver were recovered. This company and lessees worked the Keystone mine and produced 28,697 tons of ore from which 8,167 ounces of gold and 22,554 ounces of silver were recovered by cyanidation. The Dayton Consolidated Mines Co. operated the

New York mine throughout the year. Lessees shipped 873 tons of ore from the Occidental mine to a custom cyanide mill; 176 ounces of gold and 5,848 ounces of silver were recovered. The Nevada Securities Co. worked the Overland mine. The Consolidated Chollar Gould & Savage Mining Co. operated the Overman mine continuously. The Silver Hill Mining Co. operated the Silver Hill and Succor mines and treated the ore in the company 100-ton amalgamation-cyanidation mill. Sierra Nevada, Ltd., and lessees worked the Sierra Nevada mine.

WASHOE COUNTY

White Horse district.—The Renegade mine was operated during 1941; 361 tons of ore treated by amalgamation yielded 284 ounces of gold and 88 ounces of silver, and 149 tons of ore shipped to a custom cyanide mill yielded 402 ounces of gold and 116 ounces of silver.

WHITE PINE COUNTY

Aurum district.—The Grand Deposit Mining Co. and lessees worked the Grand Deposit mine during 1941; copper ore and lead ore were shipped to a smelter and zinc ore to a zinc oxide plant for treatment.

Cherry Creek district.—Several groups of leasers on the Eagen mine in 1941 shipped to a smelter 1,656 tons of ore and 949 tons of old tailings, containing in all 461 ounces of gold and 10,502 ounces of silver. The Exchequer Mining Co. shipped silver ore from the Imperial mine to a smelter. The Nevada Standard Mining Co. and lessees shipped gold-silver ore and silver ore from the Star mine. Old tailings were shipped from the Thompson tailing pile to a smelter.

Robinson district.—The Nevada Consolidated Copper Corporation (operating subsidiary of the Kennecott Copper Corporation and largest industrial company in Nevada) operated the Ruth mine at Ruth and the open pit at Copper Flat throughout 1941. In addition to its mining activities, the company operated the McGill copper smelter (only smelter in the State) and the McGill flotation-concentrator, which was increased in 1941 from 18,000- to 20,000-ton daily capacity The Consolidated Coppermines Corporation, second-largest copper producer in the State in 1941, was active throughout the year; copper ore mined on company account was shipped to the McGill concentrator. C. Caviglia shipped from the Chainman mine to a smelter 4,517 tons of ore containing 654 ounces of gold and 5,785 ounces of silver. The Ely Gold & Manganese Co. and lessees operated the Cuba mine The Hayes mine was operated by D. F. Paine until May; operations were continued by the D. F. Paine estate. During August and September lessees shipped 598 tons of gold-silver ore, containing 113 ounces of gold, 3,145 ounces of silver, and 942 pounds of copper, from the Hidden Treasure mine to a smelter. L. Piombo operated the Jupiter Lease and shipped gold-silver ore to a smelter. L. Burnham worked the Keystone mine from March to September. The Ely Gold Mining Co. shipped gold-silver ore from the Revenue mine.

Taylor district.—Lessees shipped silver ore from the Gore mine during 1941. Farnsworth-Ely Combined Metals Mines shipped silver ore from the Mineral Farm mine to a smelter during the first 4 months of the year. Lessees worked the Monitor and Sunrise mines.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

SUMMARY

Production of both copper and zinc in New Mexico in 1941 was larger in quantity than in any previous year, and that of lead was greater than in 1940 but less than in 1939. The output of both gold

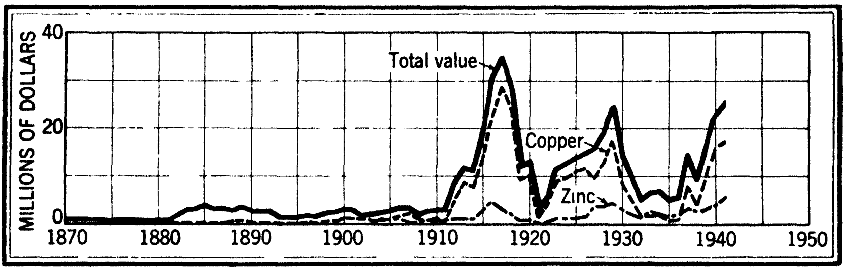

Figure 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1941. The value of gold, silver, and lead produced annually has been relatively small.

and silver decreased. The total value of the recovered output of the five metals in 1941 was $25,471,416 (highest since 1918) and compares with $22,246,421 in 1940 (see fig. 1). Copper represented 68 percent and zinc 22 percent of the total value in 1941; the zinc value was the highest in any year on record for the State, and the copper value was the largest since 1918. All the principal producing mines and mills that were active in 1940 continued operations throughout 1941, with the exception of the Aztec mine and 140-ton amalgamation-flotation mill in Colfax County and the San Pedro group and 150-ton flotation mill in Santa Fe County (shut down in August). The Waldo mine and 200-ton flotation mill near Magdalena were reopened and began producing in September.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052
1940	35.00	[6].711+	.113	.050	.063
1941	35.00	[6].711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20 67+($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938–41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

The following table shows the number of mines in New Mexico producing gold, silver, copper, lead, and zinc and their annual output of ore and metals from 1937 to 1941; also the total production from 1848 to 1941. The report of this series for 1929 (chapter of Mineral Resources of the United States, 1929, pt. 1, pp. 729–759) gives the yearly production of each important metal-producing district in New Mexico from 1904 to 1929, inclusive. Subsequent records year by year may be found in annual issues of Mineral Resources and Minerals Yearbook.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1937–41, and total, 1848–1941, in terms of recovered metals

Year	Mines producing: Lode	Mines producing: Placer	Ore (short tons)	Gold (lode and placer): Fine ounces	Gold (lode and placer): Value	Silver (lode and placer): Fine ounces	Silver (lode and placer): Value
1937	159	160	4,191,092	41,171	$1,440,985	1,243,766	$962,053
1938	166	164	2,414,857	43,050	1,506,750	1,229,860	795,061
1939	214	168	4,977,375	36,979	1,294,265	1,400,878	950,899
1940	164	179	7,089,903	35,943	1,258,005	1,407,839	1,001,130
1941	145	103	7,530,226	27,845	974,575	1,328,317	944,581
1848–1941			(1)	2,148,780	48,541,493	65,276,576	51,150,206

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1937	64,106,000	$7,756,826	13,024,000	$768,416	47,854,000	$3,110,510	$14,038,790
1938	40,878,000	4,006,044	9,898,000	455,308	56,472,000	2,710,656	9,473,819
1939	92,284,000	9,597,536	10,784,000	506,848	58,712,000	3,053,024	15,402,572
1940	139,696,000	15,785,648	7,644,000	382,200	60,626,000	3,819,438	22,246,421
1941	146,956,000	17,340,808	9,336,000	532,152	75,724,000	5,679,300	25,471,416
1848–1941	[2] 1,017,444	308,878,983	[2] 244,684	23,531,731	[2] 611,830	74,886,524	506,988,937

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in New Mexico, 1937–41, in terms of recovered metals

Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value	Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value
1937	3,027	$105,945	203	$157	$106,102	1940	2,928	$102,480	263	$187	$102,667
1938	2,626	91,910	167	108	92,018	1941	2,488	87,080	284	202	87,282
1939	3,474	121,590	209	142	121,732						

Gold.—Mine production of gold in New Mexico decreased from 35,943 fine ounces in 1940 to 27,845 ounces in 1941. Changes in output in the principal gold-producing districts in 1941 were: Decreases of 1,877 ounces in the Mogollon district, 570 ounces in the Mount Baldy, 951 ounces in the Hillsboro, 1,737 ounces in the Central, 955 ounces in the Lordsburg, 1,641 ounces in the San Pedro, and 359 ounces in the Pinos Altos district; output increased 1,271 ounces in the Steeple Rock district. Dry and siliceous ores yielded 57 percent of the State total gold, copper ore 32 percent, lead and zinc-lead ores 2 percent, and placers 9 percent.

Silver.—Mine production of silver in New Mexico was 1,328,317 fine ounces in 1941 compared with 1,407,839 ounces in 1940. The Mogollon district contributed 37 percent of the State total in 1941, Central 36 percent, Steeple Rock 19 percent, Lordsburg 5 percent, and San Pedro 1 percent. Dry and siliceous ores yielded 57 percent of the total silver; copper ore 18 percent; zinc-lead ore 24 percent; and lead ore, together with a small quantity of silver from placers, 1 percent.

Copper.—The output of recoverable copper from mines in New Mexico in 1941 was 146,956,000 pounds—a 5-percent increase over the former record annual production (in 1940). The Chino open-pit mine of the Nevada Consolidated Copper Corporation at Santa Rita, Grant County, continued to be much the largest producer in the State. The daily capacity of the concentrator at Hurley was 20,000 tons at the end of 1941. The copper concentrates are reduced to blister copper in the smelter adjacent to the concentrator. Molybdenite concentrates are recovered in the mill as a byproduct. Other sizable producers of copper were the Burro Mountain group of the Phelps Dodge Corporation at Tyrone, Grant County; the Bonney mine near Lordsburg, Hidalgo County; the San Pedro near Golden, Santa Fe County (operated January to August); and the Ground Hog-San Jose group near Hanover, Grant County. Copper ore and mine-water precipitates yielded 98 percent of the total copper; most of the remainder was recovered from concentrates produced from the milling of zinc-lead ore.

Lead.—The bulk of the lead produced from New Mexico mines in 1941 came from the American Smelting & Refining Co. Ground Hog unit in the Central district, Grant County. The total State output of lead (9,336,000 pounds) was 22 percent above that in 1940. Zinc-lead ore yielded 88 percent of the total lead, lead ore 5 percent, copper ore 5 percent, and other types of ore 2 percent.

Zinc.—The output of recoverable zinc from mines in New Mexico increased 25 percent in 1941 over 1940. The principal producers in 1941 were the American Smelting & Refining Co. (Ground Hog unit), Empire Zinc Co. (Hanover mine group), and the Peru Mining Co. (Pewabic mine), all in the Central district, Grant County; and Raskob Mining Interests, Inc. (Waldo mine operation) and the Empire Zinc Co. (Kelly group), both in the Magdalena district, Socorro County. Other districts producing some zinc were the Organ, Dona Ana County; Pinos Altos and Swartz, Grant County; and Lordsburg and San Simon, Hidalgo County.

Zinc concentrates produced in 1941 amounted to 80,774 tons, containing as shipped 20 ounces of gold, 56,215 ounces of silver, 603,467 pounds of copper, 1,117,017 pounds of lead, and 87,362,425 pounds of zinc. The average content in zinc was therefore 54.08

percent. The zinc and zinc-lead ores (1,492 tons) from New Mexico shipped crude to the Ozark pigment plant at Coffeyville, Kans., averaged 22.86 percent zinc and 12.40 percent lead.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Bernalillo	1		4	$140	1,014	$721
Catron	9		7,884	275,940	489,943	348,404
Colfax		6	703	24,605	97	69
Dona Ana	3				97	69
Eddy	1				3	2
Grant	68	20	14,793	517,755	737,003	524,091
Guadalupe	1				232	165
Hidalgo	10		1,357	47,495	67,815	48,224
Lincoln	3	19	231	8,085	758	539
Luna	5				218	155
Santa Fe	6	16	1,157	40,495	17,384	12,362
Sierra	27	42	1,518	53,130	5,518	3,924
Socorro	11		198	6,930	8,235	5,856
	145	103	27,845	974,575	1,328,317	944,581
Total, 1940	164	179	35,943	1,258,005	1,407,839	1,001,130

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Bernalillo							$861
Catron	600	$71					624,415
Colfax							24,674
Dona Ana			12,000	$684	12,000	$900	1,653
Eddy	500	59					61
Grant	137,814,000	16,262,052	8,165,000	465,405	70,473,000	5,285,475	23,054,778
Guadalupe	204,000	24,072					24,237
Hidalgo	7,468,800	881,318	221,000	12,597	80,000	6,000	995,634
Lincoln			200	11			8,635
Luna	200	24	26,400	1,505			1,684
Santa Fe	1,437,000	169,566					222,423
Sierra	23,400	2,761	7,400	422			60,237
Socorro	7,500	885	904,000	51,528	5,159,000	386,925	452,124
	146,956,000	17,340,808	9,336,000	532,152	75,724,000	5,679,300	25,471,416
Total, 1940	139,696,000	15,785,648	7,644,000	382,200	60,626,000	3,819,438	22,246,421

Gold and silver produced at lode mines in New Mexico in 1941, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Bernalillo	16	4	1,014	Luna	45		218
Catron	61,734	7,884	489,943	Santa Fe	27,376	1,052	17,377
Dona Ana	47		97	Sierra	4,852	467	5,459
Eddy	9		3	Socorro	28,547	198	8,235
Grant	7,281,457	14,342	736,896				
Guadalupe	2,411		232		7,530,226	25,357	1,328,033
Hidalgo	123,557	1,357	67,815	Total, 1940	7,089,903	33,015	1,407,576
Lincoln	175	53	744				

Gold and silver produced at placer mines in New Mexico in 1941, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Colfax	26	4	677	93	703	97
Grant	81	19	370	88	451	107
Lincoln	178	14			178	14
Santa Fe	105	7			105	7
Sierra	96	5	955	54	1,051	59
	486	49	2,002	235	2,488	284
Total, 1940	651	58	2,277	205	2,928	263

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The greater part of the 7,530,226 tons of ore produced in New Mexico in 1941 was copper ore, mined with power shovels, from the Chino open-pit mine at Santa Rita, Grant County. Underground mining was done at the other principal mines of the State. The quantity of each type of ore produced, with its content in terms of recovered metals, is shown in the table that follows. Operating details at both lode and placer mines are given in the following review by counties and districts.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in New Mexico in 1941, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	18,305	4,360	18,036	66,414	225,555	
Dry and siliceous gold-silver ore	89,430	11,598	728,462	7,267	2,206	
Dry and siliceous silver ore	282	8	7,732	899	6,494	
	108,017	15,966	754,230	74,580	234,255	
Copper ore	6,975,682	8,908	242,834	[1] 144,714,904	429,254	
Lead ore	2,261	423	7,200	9,827	450,987	
Zinc ore	148,359				382	26,586,093
Zinc-lead ore	295,907	60	323,769	2,156,689	8,221,122	49,137,907
	7,422,209	9,391	573,803	[1] 146,881,420	9,101,745	75,724,000
Total, lode mines	7,530,226	25,357	1,328,033	[1] 146,956,000	9,336,000	75,724,000
Total, placers		2,488	284			
	7,530,226	27,845	1,328,317	[1] 146,956,000	9,336,000	75,724,000
Total, 1940	7,089,903	35,943	1,407,839	[2] 139,696,000	7,644,000	60,626,000

[1] Includes 16,818,294 pounds of copper recovered from mine-water precipitates.
[2] Includes 8,258,984 pounds of copper recovered from mine-water precipitates.

METALLURGIC INDUSTRY

The following eight flotation mills treated 98 percent of the total New Mexico output of ore in 1941: Chino at Hurley, Empire Zinc at Hanover, Banner near Lordsburg, Peru near Deming, Combination near Hanover, San Pedro near Golden, Waldo near Magdalena, and Southwest Minerals near Duncan, Ariz. (operated on ore from the Carlisle group at Steeple Rock, N. Mex.). One percent was treated by the Little Fanney cyanidation mill at Mogollon, the East Camp cyanidation mill at Steeple Rock, and scattered small concentration and amalgamation mills; and 1 percent was shipped crude to smelters. The Chino reverberatory copper smelter of the Nevada Consolidated Copper Corporation at Hurley was operated throughout 1941 on company copper concentrates, siliceous copper ore, and copper precipitates recovered by leaching of waste dumps. Concentrates and ore produced by other operators in the State were shipped to smelters in other States, mentioned in the following review by counties and districts. About 300,250 cubic yards of gravel were treated at four placer mines using dry-land dredges, and some gravel for which figures are not obtainable was handled at small placers worked by hand methods.

Mine production of metals in New Mexico in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	5,908	986	249			
Ore cyanided [1]	84,611	10,081	690,217			
Concentrates smelted	313,725	10,757	518,113	[2] 144,281,312	8,173,537	75,179,301
Ore smelted	86,757	3,533	119,454	2,674,688	1,162,463	544,699
Placer		2,488	284			
		27,845	1,328,317	146,956,000	9,336,000	75,724,000
Total, 1940		35,943	1,407,839	139,696,000	7,644,000	60,626,000

[1] Cyanide used was approximately 342,800 pounds of Aero Brand calcium cyanide (approximately 48 to 49 percent NaCN).
[2] Includes 16,818,294 pounds of copper recovered from smelting of mine-water precipitates.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in New Mexico in 1941, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Catron	61,460	7,720	484,827					
Grant	23,776	3,100	205,451					
Santa Fe	780	193	54	3	7	3	75	
Sierra	4,300	16	5	81	191	777	9,288	878
Socorro	203	38	129					
	90,519	11,067	690,466	84	198	780	9,363	878
Total, 1940	112,784	12,698	680,751	176	860	700	1,092	

Mine production of metals from concentrating mills in New Mexico in 1941, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dona Ana	7	2		3		965	
Grant	7,176,912	291,592	8,421	428,631	[1] 135,367,068	7,634,993	70,467,598
Hidalgo	123,330	14,222	1,270	65,015	7,467,803	184,617	80,000
Lincoln	50	10		642		200	
Santa Fe	26,554	2,445	838	17,317	1,436,925		
Sierra	100	9	19	645	153		
Socorro	25,997	5,361	11	5,080		351,884	4,631,703
	7,352,950	313,641	10,559	517,333	[1] 144,271,949	8,172,659	75,179,301
Total, 1940	6,877,449	276,562	11,944	425,484	[2] 134,579,892	5,879,669	60,120,764

BY CLASSES OF ORE CONCENTRATED

	Ore treated (short tons)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	8,015	477	1,673	8,373	30,400	153,900	
Dry and siliceous gold-silver	100	9	19	645	153		
Dry and siliceous silver	50	10		642		200	
Copper	6,901,193	222,411	8,807	183,808	[1] 142,084,707	35,500	
Lead	818	56		96		57,565	
Zinc	148,334	30,398					26,580,691
Zinc-lead	294,440	60,280	60	323,769	2,156,689	7,925,494	48,598,610
	7,352,950	313,641	10,559	517,333	[1] 144,271,949	8,172,659	75,179,301

[1] Includes 16,818,294 pounds of copper recovered from mine-water precipitates.
[2] Includes 8,258,984 pounds of copper recovered from mine-water precipitates.

Gross metal content of concentrates produced from ores mined in New Mexico in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	5	18	16	87	21	
Dry gold-silver	9	19	645	201		
Dry silver	10		642		318	
Copper	222,492	8,998	184,585	[1] 145,207,294	66,159	
Lead	381	18	6,600	2,467	364,355	7,792
Lead-copper	10,054	1,686	269,507	2,097,520	7,932,845	1,647,303
Zinc	80,774	20	56,215	603,467	1,117,017	87,362,425
	313,725	10,759	518,210	[1] 147,911,036	9,480,715	89,017,520
Total, 1940	276,738	12,824	437,301	[2] 137,321,764	7,131,824	69,095,180

[1] Includes 17,185,932 pounds of copper contained in mine-water precipitates.
[2] Includes 8,384,755 pounds of copper contained in mine-water precipitates.

Mine production of metals from New Mexico concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dona Ana	2		3		965	
Grant	291,592	8,421	428,631	[1] 135,367,068	7,634,993	70,467,598
Hidalgo	14,222	1,270	65,015	7,467,803	184,617	80,000
Lincoln	10		642		200	
Santa Fe	2,448	845	17,320	1,437,000		
Sierra	90	210	1,422	9,441	878	
Socorro	5,361	11	5,080		351,884	4,631,703
	313,725	10,757	518,113	[1] 144,281,312	8,173,537	75,179,301
Total, 1940	276,738	12,804	426,184	[2] 134,580,984	5,879,669	60,120,764

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	5	18	16	75		
Dry gold-silver	9	19	645	153		
Dry silver	10		642		200	
Copper	222,492	8,998	184,585	[1] 142,093,995	36,378	
Lead	381	18	6,600	1,663	327,809	
Lead-copper	10,054	1,686	269,507	1,702,663	7,094,190	
Zinc	80,774	18	56,118	482,763	714,960	75,179,301
	313,725	10,757	518,113	[1] 144,281,312	8,173,537	75,179,301

[1] Includes 16,818,294 pounds of copper recovered from mine-water precipitates.
[2] Includes 8,258,984 pounds of copper recovered from mine-water precipitates.

Gross metal content of New Mexico crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	4,382	2,003	8,634	28,135	128,519	
Dry and siliceous gold-silver	4,719	998	37,600	7,603	4,061	2,837
Dry and siliceous silver	232	8	7,090	1,051	7,676	
Copper	74,489	101	59,026	2,710,014	715,927	
Lead	1,443	423	7,104	12,292	436,808	77,888
Total to copper and lead plants	85,265	3,533	119,454	2,759,095	1,292,991	80,725
Zinc	25				505	6,718
Zinc-lead	1,467				369,465	674,762
Total to zinc plants	1,492				369,970	681,480
	86,757	3,533	119,454	2,759,095	1,662,961	762,205
Total, 1940	99,670	7,513	300,641	5,308,184	2,777,568	662,634

Mine production of metals from New Mexico crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Bernalillo	16	4	1,014			
Catron	274	164	5,116	600		
Dona Ana	40		94		11,035	12,000
Eddy	9		3	500		
Grant	80,769	2,821	102,814	2,446,932	530,007	5,402
Guadalupe	2,411		232	204,000		
Hidalgo	227	87	2,800	997	36,383	
Lincoln	125	53	102			
Luna	45		218	200	26,400	
Santa Fe	42	14	3			
Sierra	452	241	4,032	13,959	6,522	
Socorro	2,347	149	3,026	7,500	552,116	527,297
	86,757	3,533	119,454	2,674,688	1,162,463	544,699
Total, 1940	99,670	7,513	300,641	5,115,016	1,764,331	505,236

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	4,382	2,003	8,634	26,651	70,777	
Dry and siliceous gold-silver	4,719	998	37,600	7,114	2,206	
Dry and siliceous silver	232	8	7,090	899	6,294	
Copper	74,489	101	59,026	2,630,197	393,754	
Lead	1,443	423	7,104	9,827	393,422	
Total to copper and lead plants	85,265	3,533	119,454	2,674,688	866,453	
Zinc	25				382	5,402
Zinc-lead	1,467				295,628	539,297
Total to zinc plants	1,492				296,010	544,699
	86,757	3,533	119,454	2,674,688	1,162,463	544,699

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Bernalillo County	1		16	4		4	1,014		1,014				$861
Catron County													
Mogollon	8		61,732	7,884		7,884	489,926		489,926	600			624,403
Wilcox	1		2				17		17				12
Colfax County, Mount Baldy		6			703	703		97	97				24,674
Dona Ana County, Organ	3		47				97		97		12,000	12,000	1,653
Eddy County	1		9				3		3	500			61
Grant County													
Burro Mountain	2	1	17	11	3	14	509		509	2,287,000			270,718
Central	12		7,231,981	6,893		6,893	476,138		476,138	135,454,500	7,804,600	69,297,000	22,205,610
Chloride Flat	3		9				436		436	500	800		415
Eureka [1]	4		28	2		2	1,156		1,156		9,200		1,416
Pinos Altos	28	16	9,811	725	444	1,169	4,576	107	4,683	10,500	62,100	1,089,000	130,699
Steeple Rock	9		39,018	6,685		6,685	252,509		252,509	53,200	226,000		432,697
Swartz	1		502	1		1	516		516	2,900	56,400	87,000	10,494
Telegraph	3		23				710		710		5,900		841
White Signal	6	3	68	25	4	29	346		346	5,400			1,898
Guadalupe County	1		2,411				232		232	204,000			24,237
Hidalgo County													
Eureka [1] (Sylvanite)	3		124	86		86	2,340		2,340	300	400		4,732
Gillespie	1		88	1		1	398		398	200	32,200		2,177
Lordsburg	5		121,145	1,270		1,270	63,886		63,886	7,467,300	48,000	12,000	974,657
San Simon	1		2,200				1,191		1,191	1,000	140,400	68,000	14,068
Lincoln County													
Cedar Creek	1		51				720		720		200		523
Jicarilla		19			178	178		14	14				6,240
White Oaks	2		124	53		53	24		24				1,872
Luna County, Cooks Peak	5		45				218		218	200	26,400		1,684
Santa Fe County													
Ortiz Mountains (Cerrillos)	1	5	42	14	49	63	3	3	6				2,209
San Pedro	5	11	27,334	1,038	56	1,094	17,374	4	17,378	1,437,000			220,214
Sierra County													
Chloride	8		187	29		29	2,496		2,496	3,000	5,000		3,429
Kingston	3		84	6		6	1,457		1,457	400	1,300		1,367
Las Animas (Hillsboro)	16	4	4,581	432	989	1,421	1,506	56	1,562	20,000	1,100		53,269
Pittsburg and Caballos Mountains		38			62	62		3	3				2,172

Socorro County													
Magdalena	6	--------	27,381	133	--------	133	7,972	--------	7,972	7,500	847,400	5,159,000	446,436
Mocking Bird	1	--------	811	--------	--------	--------	93	--------	93	--------	56,600	--------	3,292
Rosedale	1	--------	200	35	--------	35	128	--------	128	--------	--------	--------	1,316
San Mateo Mountains	1	--------	52	16	--------	16	28	--------	28	--------	--------	--------	580
Silver Mountain	2	--------	103	14	--------	14	14	--------	14	--------	--------	--------	500
Total New Mexico	145	103	7,530,226	25,357	2,488	27,845	1,328,033	284	1,328,317	146,956,000	9,336,000	75,724,000	25,471,416

[1] District lies in both Grant and Hidalgo Counties

BERNALILLO COUNTY

F. S. Hofheims shipped 16 tons of silver-gold ore from the Little Daisy claim to the El Paso smelter in 1941.

CATRON COUNTY

Mogollon district.—The Black Hawk Consolidated Mines Co. continued in 1941 to operate the Consolidated group (comprising the Andrew Jackson Consolidated, Lexington Contention, and Lexington Gunboat claims on the Queen vein) and the Little Fanney cyanide mill, both under lease from the Lehigh Metals Co. Besides ore from the Consolidated group, the mill treated custom ore from the Little Fanney, Maude S, Champion, Last Chance, and Pacific groups. Company and custom ore treated totaled 61,460 tons, from which 7,720 fine ounces of gold and 484,827 fine ounces of silver were recovered in bullion shipped to the Denver Mint. Some of the ore produced at the Last Chance group and a few lots of ore from the Bearup and Ruby properties were shipped crude to the El Paso smelter and Hawley & Hawley (ore buyers) at Douglas, Ariz.

Wilcox district.—In 1941 the owner of the Little Dry claim shipped 2 tons of ore to the Ira L. Wright assay office at Silver City; the ore assayed 0.14 ounce of gold and 8.4 ounces of silver to the ton.

COLFAX COUNTY

Mount Baldy district (Baldy, Elizabethtown, Eagle Nest).—All the output of gold and silver from the Mount Baldy district in 1941 came from placer mines. Fullroe, Inc., worked the Lynch Homestead and Grouse Gulch placers about 8 months, using a caterpillar bulldozer, 1¼-cubic yard dragline, and portable screening and sluicing plant. The Peerless Mining Co. operated its portable four-bowl washing machine, 1¼-cubic yard gasoline shovel, and caterpillar bulldozer from April 12 to November 17 on placer ground on Ute Creek. Individuals recovered small lots of placer gold by sluicing near Elizabethtown. No activity in mining or development was reported at lode mines in the Mount Baldy district in 1941. The mills at the Aztec and French Henry mines were dismantled.

DONA ANA COUNTY

Organ district.—A car of zinc-lead ore cleaned up from dumps on the Rickardite property was shipped to the Ozark Smelting & Mining Co. at Coffeyville, Kans., in 1941. About 6 tons of lead-silver ore were shipped to the El Paso smelter from the Seale & Hoffer group of claims, and a little ore was shipped from a prospect on which assessment work was being done.

EDDY COUNTY

Orvan F. Ammann shipped 9 tons of copper-silver ore to the El Paso smelter from his claim northwest of Carlsbad.

GRANT COUNTY

Burro Mountain district (Tyrone).—In March 1941 the Phelps Dodge Corporation began preparing its Burro Mountain mine (idle since

1921) for leaching. Water lines, power lines, and pumps were installed, and a precipitation plant was built. Production of copper was begun May 22 and continued the rest of the year. A lessee at the Barrio claim, owned by the Standard Silver Lead Mining Co., shipped small lots of gold-silver ore to buyers at Silver City, N. Mex., and Douglas, Ariz. Dry washing on placer ground in the Burro Mountain district recovered a little gold.

Central district (Bayard, Fierro, Georgetown, Hanover, Santa Rita).—The Nevada Consolidated Copper Corporation Chino Mines Division, largest producer of copper in New Mexico, operated its open-pit mine at Santa Rita and flotation mill and reverberatory copper smelter at Hurley throughout 1941. The output of copper was larger than in 1940 and set a new annual record. Improvements made in the mill in 1941 raised its capacity from 17,500 to 20,000 tons daily. The copper concentrates carry a low content of gold and silver. Molybdenite concentrates are recovered in the mill as a byproduct. The material smelted in 1941 included, besides concentrates from the mill, a considerable tonnage of siliceous carbonate copper ore (used as a flux) and copper precipitates recovered from leaching operations. The Twenty-seventh Annual Report of the Kennecott Copper Corporation, dated March 10, 1942, contains the following paragraphs regarding operations at the Chino property during 1941:

A total of 94,889,612 tons of rock was mined and moved at the four properties in Utah, Nevada, Arizona, and New Mexico. Of this total 51,180,803 tons were overburden which went to the waste dumps and 43,708,809 tons were ore sent to the concentrators. The average assay of the ore was 1.04 percent copper and there was produced a total of 819,648,759 pounds of copper during the year. The average monthly production was thus slightly in excess of 34,000 tons—varying from about 32,000 tons in the earlier months to 36,000 tons in the latter part of the year.

Chino mines.—The full electrification of the open-pit mine at Santa Rita was completed with the purchase of additional electric locomotives to replace the last of the steam motive power. Other new mine equipment included one 5-yard electric shovel and 20 dump cars. Sixteen new houses and a theater were built at the mine townsite.

At the mill and smelter at Hurley—about 8 miles from Santa Rita—the installation of a 230-foot diameter Dorr thickening tank was started, and a new lime-burning plant was nearly completed at the year end. Four wells were drilled to augment the water supply developing an initial flow of 800 gallons per minute. This additional gallonage together with the water that will be saved through the Dorr thickener installation should provide a sufficient supply to treat present ore tonnages in seasons of normal rainfall. Eight houses and a teachers' dormitory were constructed at the Hurley townsite.

Zinc production in the Central district rose 17 percent over 1940. The Peru Mining Co. expanded mining operations at its Pewabic mine and shipped a materially increased tonnage of ore to the company 500-ton mill near Deming. Besides ore from the Pewabic mine, the mill handled some zinc tailings from the Cleveland mine near Pinos Altos. The concentrates produced were shipped to the retort plant at Dumas, Tex. The Empire Zinc Co. operated its Hanover mine group and selective-flotation mill continuously in 1941. Although the quantity of zinc concentrates produced from Hanover ore was less than in 1940, the decline from this source was partly offset by concentrates made from ore shipped to the mill from the company Kelly mine in the Magdalena district, Socorro County. Most of the zinc concentrates produced were shipped to the New Jersey Zinc Co. plant at Depue, Ill. (Mineral Point Zinc Division); the byproduct

lead-copper concentrates made were shipped to the El Paso smelter. Zinc concentrate production from the Combination (Black Hawk) mill, operated under lease by the American Smelting & Refining Co., was nearly double that in 1940, and lead concentrate production also increased. Most of the ore treated came from the company Ground Hog-San Jose group which produced, in addition to mill-grade zinc-lead-copper-silver ore, a substantial tonnage of copper-lead-silver-gold and lead-copper-silver ores shipped crude to the El Paso smelter. The zinc concentrates produced were shipped to the Amarillo (Tex.) smelter and the lead-copper concentrates to El Paso. The mill handled considerable custom ore from the Combination and Hobo mines of the Black Hawk Consolidated Mines Co. and smaller quantities from the Bullfrog mine in the Central district, the Grandview in the Swartz (Carpenter) district, the Silver Hill near Pinos Altos, and the Ruth near Lordsburg. A few cars of ore were shipped to smelters from the Hanover Bessemer Iron & Copper Co. group, Lead King mine, and other properties in the Central district.

Chloride Flat district.—Small lots of lead-silver ore from the Hot Spot and Silver Queen claims and copper-silver ore from the Silver Monument were sold to Ira L. Wright, assayer and ore buyer at Silver City, in 1941.

Eureka district (see also Hidalgo County).—The output from the Grant County part of the Eureka district in 1941 comprised small lots of ore (mostly lead-silver) shipped through Ira L. Wright of Silver City from the American, Cherokee, Green Horn, and Hornet claims.

Pinos Altos district.—Zinc was the metal of chief value produced in the Pinos Altos district in 1941; most of it was contained in old tailings from the Cleveland dump shipped to the Peru mill at Deming. Some zinc-lead ore was treated in the 20-ton Calumet mill, and 19 tons were shipped from the Silver Hill mine to the Combination mill near Hanover. Gold-silver and gold-silver-lead-copper ores were shipped (mostly in small lots) to the El Paso smelter, Ira L. Wright at Silver City, and Hawley & Hawley at Douglas, Ariz., from various mines, dumps, and prospects in the Pinos Altos district. Among those producing more than 25 tons of ore were the Langston, Lupita No. 2, Pacific, and Wild Bill. Most of the output of placer gold from the Pinos Altos district in 1941 was recovered by Cooperative Placers, which operated a dragline land dredge in Santa Domingo Gulch.

Steeple Rock district.—The Southwest Mineral Co. operated the Carlisle group from January 2 through December 1941 and produced 11,313 tons of gold-silver-copper ore, of which 7,913 tons were concentrated in the company 75-ton flotation mill at Duncan, Ariz., and 3,400 tons were shipped crude to the El Paso smelter. Mine development done included a 300-foot vertical shaft and 250 feet of drifts. The Exploration Syndicate, Inc., continued to operate the East Camp group; most of the ore produced was treated in the company cyanide mill at the mine, and the gold-silver bullion recovered was shipped to the Denver Mint; a few cars of crude ore were shipped to the El Paso smelter. Other shippers of crude ore to the El Paso smelter or the International Smelting & Refining Co. smelter at Miami, Ariz., were the Eureka group, Homestake, Jim Crow, Laura, Mount Royal, New Year's Gift, and Ontario.

Swartz (or Carpenter or Camp Monarch) district.—The Black Range Development Co. worked the Grandview group from January through April 1941 and produced 502 tons of ore averaging 11.6 percent zinc, 7.1 percent lead, and 0.4 percent copper, and 1.1 ounces of silver and 0.003 ounce of gold to the ton; the ore was sold to the Combination mill near Hanover.

Telegraph district.—Small lots of lead-silver and silver ore were shipped through ore buyers (Ira L. Wright at Silver City and Hawley & Hawley at Douglas, Ariz.) from the Calard No. 2, Cora Miller, and Slate Creek claims.

White Signal district.—Only small-scale intermittent mining was done in the White Signal district in 1941, and the ore produced (mostly copper-silver) was shipped crude through Ira L. Wright at Silver City to El Paso or direct to the United Verde smelter at Clarkdale, Ariz. Among the producing lode claims were the Big Chief, Bisbee, Combination, Reward, and True Blue No. 1. Sluicing in Gold Gulch recovered a little placer gold.

GUADALUPE COUNTY

Alex. Bonnyman, Jr., worked the Stauber mine, in secs. 6 and 7, T. 7 N., R. 20 E. of the New Mexico principal meridian, under lease throughout 1941 and shipped to the El Paso smelter 2,411 tons of ore averaging 4.41 percent copper and 0.097 ounce of silver to the ton.

HIDALGO COUNTY

Eureka (Sylvanite) district (see also Grant County).—Small tonnages of smelting ore were shipped in 1941 from the Hardscrabble group and the Howell and Rincon claims.

Gillespie (Red Hill) district.—The Hope Mining Co., lessee at the Red Hill group, shipped 88 tons of lead-silver ore containing a little gold and copper to the El Paso smelter in 1941.

Lordsburg district.—The Banner Mining Co. operated the Bonney mine and 500-ton flotation mill 6 miles south of Lordsburg continuously in 1941. The ore produced from the various levels of the mine is hoisted through a 1,300-foot vertical main shaft 100 feet from the mill. The product of the mill is copper-gold-silver-[iron] concentrates, which are sold to the El Paso smelter. During the year the company unwatered the old Anita mine about 5 miles west of Lordsburg, reconditioned the 800-foot shaft, and began doing development work. The ore will be hauled to the mill at the Bonney mine for treatment. A road connecting the two properties was built. J. A. Werme shipped 55 tons of zinc-lead ore from the leased Ruth property to the Combination mill at Hanover (Grant County). Small lots of direct-smelting ore were shipped from the Blue Bird No. 2, C. G. N. S., and Francis K. Sweet claims.

San Simon district (Steins).—The McGhee 75-ton flotation mill at the McGhee mine 3 miles south of Steins was operated part of 1941 on zinc-lead-silver ore from the Crystal group. About 2 cars each of lead-silver concentrates and zinc concentrates were produced and shipped.

LINCOLN COUNTY

Cedar Creek district.—A lessee worked the Silver Cap No. 2 claim on a small scale in the spring of 1941 and produced some silver-lead-

copper ore, most of which was concentrated in the 20-ton mill on the property.

Jicarilla district.—Placer miners continued to recover gold in 1941 by dry washing, rocking, and sluicing in the Jicarilla Mountains southeast of Ancho.

White Oaks district.—A few cars of gold-silver ore were shipped from mines in the White Oaks district to the El Paso smelter in 1941.

LUNA COUNTY

Cooks Peak district.—Small tonnages of lead-silver ore were shipped through Ira L. Wright at Silver City in 1941 from the Busted Banker, Ethel-"85", Gladys, Graphic, and Mickey properties.

Deming.—In 1941 the Peru Mining Co. operated continuously its 500-ton selective-flotation mill at Wemple near Deming and treated mostly company zinc ore from the Pewabic mine in the Central district, Grant County, with some custom ore from the Central and Pinos Altos districts in Grant County. The output of zinc concentrates from the mill increased 50 percent over 1940.

SANTA FE COUNTY

Ortiz Mountains district (Cerrillos).—The only output from lode mines in the Ortiz Mountains district in 1941 was 42 tons of gold-silver-copper ore shipped from a prospect. Sluicing and dry washing on the Ortiz Grant southeast of Cerrillos recovered small lots of placer gold.

San Pedro or New Placers district.—Raskob Mining Interests, Inc., operated its San Pedro mine and 150-ton flotation mill from January 1 to August 15, 1941, and treated 26,554 tons of ore yielding 2,445 tons of concentrates containing 838 ounces of gold, 17,317 ounces of silver, and 1,496,780 pounds of copper. A lessee worked the Candelari mine on a small scale and trucked the ore produced 3½ miles to his 25-ton amalgamation-concentration mill at Golden for treatment. At the Old Timer mine 200 tons of ore were treated in a Huntington mill. Small quantities of gold were recovered from other lode mines and prospects in the San Pedro district. Individuals continued to work placer mines in the vicinity of Golden with sluices and dry washers.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—Only intermittent small-scale mining was done in the Chloride district in 1941. The ore produced was shipped in small lots direct to the El Paso smelter, or through Ira L. Wright at Silver City to El Paso and Hawley & Hawley at Douglas (Ariz.) to the Douglas smelter. Among the producing properties were the Apache group, Depression, Minnehaha, and New Era.

Kingston district.—Small tonnages of smelting ore were shipped from the Comstock, B. R., and Virginia properties in 1941.

Las Animas district (Hillsboro).—The Black Dome Mining Corporation built a 60-ton gravity- and flotation-concentration mill on Percha Creek 1 mile east of Hillsboro and operated it about 5 months in 1941 on ore and old tailings from the Snake-Opportunity-Litel King group and the Golden Era and Biglow mines. The mill feed totaled 4,300 tons, comprising 300 tons of newly mined ore and 4,000 tons of old tailings. The concentrates produced, containing gold,

silver, copper, and a little lead, were sold to the El Paso smelter. The Black Peak Mining Co. operated the Wicks mine a few months and shipped several cars of gold-silver-copper ore. Among the shippers of less than a car of ore during the year were the Duke, Tressness (formerly Garfield-Butler), and Tremont groups.

The John I. Hallett Construction Co. continued throughout 1941 to operate its movable dry-land Coulter-Ainlay four-bowl gold-recovery plant on placer ground 6 miles northeast of Hillsboro. The excavating unit consists of two butane-powered draglines of 1 and 1¼ cubic yards capacity, respectively. Drift mining at the Jones Hill placer and sluicing at other placers in the Hillsboro district recovered some gold.

Pittsburg and Caballos Mountains district.—Individuals, local and itinerant, panned for gold in 1941 on placer ground in the Pittsburg and Caballos Mountains district; the yield was sold through the Myers Co. store at Hatch.

SOCORRO COUNTY

Magdalena district.—The output of recoverable zinc from the Magdalena district rose from 411,000 pounds in 1940 to 5,159,000 pounds in 1941 and lead from 129,000 to 847,400 pounds. On April 1, 1941, Raskob Mining Interests, Inc., took an option on the Waldo mine and 200-ton flotation mill, owned by The Sherwin-Williams Co., and began preparing them for operation. The mine had been idle and full of water for many years. Pumping was begun in June, and the mine and mill were placed upon an operating basis in September; unwatering of the mine, however, was not completed until February 1942. Ore milled in 1941 totaled 20,211 tons, yielding 3,206 tons of concentrates averaging 53.2 percent zinc and 3.5 percent lead; the concentrates were shipped to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans. The Kelly mine of the Empire Zinc Co. was worked by lessees, who shipped zinc-lead ore to the Empire Zinc Co. flotation mill at Hanover and the Ozark Smelting & Mining Co. pigment plant, and lead-silver ore to the El Paso smelter. Victor Papa shipped 264 tons of lead-silver-gold-copper ore from the Papa property to the El Paso smelter; a few lots of lead-silver ore were shipped from prospects.

Mocking Bird district.—From July to December 31, 1941, the Mocking Bird Mining Co. drove a 250-foot incline shaft at the Mocking Bird group (formerly Independence group) and produced 811 tons of lead ore, which was concentrated in the company jig-concentration mill built in 1941 at Tokay (7 miles southeast of San Antonio) 28 miles from the mine. The mill recovered 54 tons of concentrates averaging 58.34 percent lead and 1.69 ounces of silver to the ton.

Rosedale district.—Bullion containing 35 fine ounces of gold and 128 fine ounces of silver was shipped from the Rosedale mine to the Denver Mint in 1941.

San Mateo Mountains district.—Ellison Warren shipped 52 tons of gold-silver ore to the El Paso smelter in 1941.

Silver Mountain (or Water Canyon) district.—Test runs made in 1941 on ore from the Open Cut mine, in the gravity-concentration mill on the property, yielded some gold and silver. A little gold was recovered from the Springtime claim.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

SUMMARY

After an all-time record in 1940, the total value of gold, silver, copper, and lead recovered from ores, old tailings, and gravels in Oregon declined 13 percent in 1941. Rising wages, migration of miners to war industries, rising costs of supplies and materials and difficulties in obtaining them, higher taxes, and fixed prices for gold and silver were factors in reversing a trend that had more than doubled the total value of the four metals since 1937.

The total value of the gold, silver, copper, and lead (in terms of recovered metals) produced in Oregon was $3,602,468 in 1941 compared with $4,148,271 in 1940. It was divided among the metals as follows: Gold, 94 percent; silver, 5 percent; and copper and lead combined, 1 percent. No recovery of zinc has been reported since 1937. Baker County continued to be the leading metal producer and contributed 42 percent of the State total value; Grant County yielded 30 percent, Jackson County 15 percent, Josephine County 8 percent, and the other 11 producing counties 5 percent. Distribution of production by counties was much the same as in 1940.

Cornucopia Gold Mines, which worked the Cornucopia mine in the Cornucopia district of Baker County until October 31, not only continued in 1941 to be the largest producer of lode gold in Oregon but also led again in output of total gold and copper. Although the Cornucopia operation was the largest to be suspended during 1941, other important producers also closed—Cougar-Independence Lessees, Western Dredging Co., Ferris Mining Co. (dragline dredge on Bull Run Creek in Baker County), Rogers & McGinnis, H. F. England Co. (dragline dredge on Dixie Creek in Grant County and Trout Creek in Harney County), and Murphy-Murray Dredging Co.

Despite a 19-percent decline in quantity of gold recovered by dragline dredging compared with 1940, this method continued for the third successive year to be the most important source of placer gold in Oregon; gold output from connected-bucket dredges declined only 3 percent; and production by nonfloating washing plants (to which gravel was delivered by mechanical means), hydraulicking, small-scale

hand methods, and underground gravel-mining all decreased substantially.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver. 1938–41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1937–41, and total, 1852–1941, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	104	150	77,230	52,662	$1,843,170	60,564	$46,846
1938	84	157	74,936	81,729	2,860,515	100,507	64,974
1939	116	201	69,025	93,372	3,268,020	105,388	71,536
1940	112	192	105,469	113,402	3,969,070	219,112	155,813
1941	91	153	98,160	96,565	3,379,775	276,158	196,379
1852–1941			(2)	5,620,788	124,690,623	5,089,782	4,697,387

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	820,000	$99,220	218,000	$12,862	48,000	$3,120	$2,005,218
1938	76,000	7,448	46,000	2,116			2,935,053
1939	96,000	9,984	30,000	1,410			3,350,950
1940	176,000	19,888	70,000	3,500			4,148,271
1941	166,000	19,588	118,000	6,726			3,602,468
1852–1941	[3] 12,223	4,610,729	[3] 714	71,851	[3] 140	13,846	134,084,436

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figures not available.
[3] Short tons.

Gold produced at placer mines in Oregon, 1937–41, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges.					
1937	4	5,017,000	17,178	$601,230	$0.120
1938	5	7,258,000	29,006	1,015,210	.140
1939	5	6,267,000	25,028	875,980	.140
1940	6	7,580,000	24,951	873,285	.115
1941	7	6,670,000	24,131	844,585	.127
Dragline dredges: [2]					
1937	4	2,085,000	9,126	319,410	.153
1938	11	2,891,000	15,939	557,865	.193
1939	10	5,964,000	26,257	918,995	.154
1940	23	7,361,000	35,216	1,232,560	.167
1941	25	6,256,000	28,395	993,825	.159
Suction dredges. [3]					
1941	1	27,000	191	6,685	.248
Nonfloating washing plants: [4]					
1937	9	186,000	2,017	70,595	.380
1938	5	136,000	1,768	61,880	.455
1939	13	346,000	2,169	75,915	.219
1940	29	638,000	4,092	143,220	.224
1941	17	567,000	2,757	96,495	.170
Gravel hydraulically handled:					
Hydraulic.					
1937	48	366,000	2,344	82,040	.224
1938	66	731,000	3,261	114,135	.156
1939	76	440,000	2,585	90,475	.206
1940	82	599,000	2,731	95,585	.160
1941	63	683,000	2,306	80,710	.118
Small-scale hand methods [5]					
Wet					
1937	71	173,892	3,197	111,895	.643
1938	57	332,800	3,874	135,590	.407
1939	83	299,200	4,398	153,930	.514
1940	44	499,300	4,279	149,765	.300
1941	33	438,300	2,553	89,355	.204
Dry [6]					
1938	2	800	16	560	700
1939	1	400	13	455	1 138
1940	1	500	21	735	1.470
1941	1	100	3	105	1.050
Underground placers					
Drift					
1937	15	3,108	357	12,495	4.020
1938	11	5,400	467	16,345	3.027
1939	13	5,400	329	11,515	2.132
1940	10	6,200	287	10,045	1.620
1941	6	4,600	94	3,290	.715
Grand total placer					
1937	[7] 150	7,831,000	34,219	1,197,665	.153
1938	157	11,355,000	54,331	1,901,585	.167
1939	201	13,322,000	60,779	2,127,265	.160
1940	[7] 192	16,684,000	71,577	2,505,195	.150
1941	153	14,646,000	60,430	2,115,050	.144

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Includes all placer operations using dragline excavator for delivering gravel to floating washing plant
[3] Includes all placer operations using suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold, which are included under "Small-scale hand methods", no suction dredges reported for 1937–40, inclusive.
[4] Includes all placer operations using power excavator and washing plant, both on dry land, when washing plant is movable, outfit is termed "dry-land dredge."
[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.
[6] None reported for 1937.
[7] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

Gold.—Production of gold in Oregon in 1941 decreased 15 percent compared with 1940—the output from placers 16 percent and that from lode mines 14 percent. Of the total placer gold, dragline dredges recovered 47 percent, connected-bucket dredges 40 percent, nonfloating washing plants with mechanical excavators almost 5 percent, and hydraulicking and small-scale hand methods 4 percent each; recoveries by suction dredging and drift mining were relatively unimportant. Virtually all the lode gold was derived from dry ores and most (93 percent) of it from dry gold ore. Although 244 properties produced in 1941, the bulk of the gold came from relatively few mines; the following 10 properties, listed in order of output, supplied 62 percent of the State total: Cornucopia Gold Mines (gold ore), Sumpter Valley Dredging Co. (connected-bucket dredge), Porter & Co. (connected-bucket dredge), Cougar-Independence Lessees (gold ore), Northwest Development Co. (dragline dredge), Lewis Investment Co. (gold ore), the B-H Co. (dragline dredge), John Arthur (Cracker Creek group) (gold ore), Consuelo Oregon Mines (dragline dredge), and Charles C. Stearns (Alaska of Oregon) (dragline dredge). Operations at 2 of these, yielding over one-third of the gold production of the 10, were suspended before the end of 1941.

Silver.—Silver production in Oregon in 1941 increased 26 percent over 1940. Of the State total, Grant County contributed 35 percent, Jefferson County 32 percent, and Baker County 30 percent; dry gold-silver ore yielded 60 percent, dry gold ore 35 percent, placer gravel 4 percent, and silver and base-metal ores 1 percent. Nearly 61 percent of the total lode silver was recovered by concentration followed by smelting of the resulting concentrates; virtually all the rest of the output came from smelting of ore.

Copper, lead, and zinc.—Most of the copper output of Oregon in 1941 was a byproduct of ores worked primarily for their gold content. The lead output of the State, which totaled only 118,000 pounds, was derived entirely from precious-metal ores. No zinc was reported recovered.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, and lead in Oregon in 1941, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	22	31	18,503	$647,605	23,025	$805,875	41,528	$1,453,480
Coos		(3)			100	3,500	100	3,500
Curry		6			85	2,975	85	2,975
Douglas	1	9	2	70	143	5,005	145	5,075
Grant	14	21	11,522	403,270	17,383	608,405	28,905	1,011,675
Harney	1	1	1	35	294	10,290	295	10,325
Jackson	25	33	909	31,815	14,789	517,615	15,698	549,430
Jefferson	1		945	33,075			945	33,075
Josephine	20	39	4,215	147,525	3,435	120,225	7,650	267,750
Lane	4	1	20	700	3	105	23	805
Malheur	2	9	15	525	1,115	39,025	1,130	39,550
Marion	1		3	105			3	105
Wallowa		(3)			7	245	7	245
Other counties [4]		3			51	1,785	51	1,785
	91	153	36,135	1,264,725	60,430	2,115,050	96,565	3,379,775
Total, 1940	112	192	41,825	1,463,875	71,577	2,505,195	113,402	3,969,070

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1941, by counties, in terms of recovered metals—Continued

County	Silver (lode and placer) [2]		Copper		Lead		Total value
	Fine ounces	Value	Pounds	Value	Pounds	Value	
Baker	84,046	$59,766	88,000	$10,384	14,000	$798	$1,524,428
Coos	14	10					3,510
Curry	13	9					2,984
Douglas	270	192	6,000	708			5,975
Grant	96,950	68,942	16,000	1,888	64,000	3,648	1,086,153
Harney	97	69					10,394
Jackson	2,914	2,072			6,000	342	551,844
Jefferson	88,823	63,163	14,000	1,652	34,000	1,938	99,828
Josephine	891	634	16,000	1,888			270,272
Lane	1,620	1,152	2,000	236			2,193
Malheur	177	126					39,676
Marion	336	239	24,000	2,832			3,176
Wallowa							245
Other counties [4]	7	5					1,790
	276,158	196,379	166,000	19,588	118,000	6,726	3,602,468
Total, 1940	219,112	155,813	176,000	19,888	70,000	3,500	4,148,271

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Sources of total silver as follows: 1941, 264,953 ounces from lode mines and 11,205 ounces from placers: 1940, 206,317 ounces from lode mines and 12,795 ounces from placers.
[3] Output from property not classed as a "mine"
[4] Morrow and Wheeler

MINING INDUSTRY

Of the 98,160 tons of ore (including 1,185 tons of old tailings) sold or treated in Oregon in 1941, Baker County produced 38,448 tons or 39 percent, Grant County 31,788 tons (including 50 tons of old tailings) or 32 percent, and Josephine County 22,711 tons (including 625 tons of old tailings) or 23 percent. Over 89 percent of the ore was dry gold ore, and virtually all the remainder was dry gold-silver ore. In addition to the ore, 1,185 tons of old tailings, of value principally in gold, were treated.

The seven properties worked by connected-bucket dredges had one dredge each, none of which worked at more than one Oregon property during 1941; at the end of the year two operations had been suspended. Among the properties worked by dragline dredges, however, one had two dredges, and a number of the dredges worked more than one property; in consequence, 16 dragline outfits worked 25 properties. At the close of 1941, however, only 12 dragline dredges were in operation. The dragline excavators were equipped as follows: 4 with 1¼-cubic yard buckets, 3 with 1½-cubic yard buckets, 2 with 2-cubic yard buckets, and 1 each with a 5-, 3½-, 3-, 2½-, 1⁹⁄₁₀-, 1¾-, and ½-cubic yard bucket.

Reports on the use of quicksilver at Oregon placer mines indicate that 1,108 pounds were consumed during 1941. The four connected-bucket dredges reporting on such use showed none consumed in 1941; the largest of the four reported enough quicksilver regained from gravel tailings to compensate losses in handling virgin ground. For the 17 dragline dredges reporting on the use of quicksilver a recovery of 55 ounces of gold per pound was recorded, compared with a recovery of 51 ounces in 1940 and 42 ounces in 1939. The quantities of gold recovered per pound of quicksilver used at other types of placer operations in 1941 were as follows (1940 figures in parentheses): Nonfloating washing plants with mechanical excavators, 43 ounces

(13); hydraulic mines, 21 ounces (22); and small-scale hand operations, 6 ounces (5).

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Oregon in 1941, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead
	Ore	Old tailings				
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold ore	86,563	1,185	33,542	96,607	103,900	84,000
Dry and siliceous gold-silver ore	9,779		2,583	165,948	14,100	34,000
Dry and siliceous silver ore	4			178		
Copper ore	629		10	2,220	48,000	
Total, lode mines	96,975	1,185	36,135	264,953	166,000	118,000
Total, placers			60,430	11,205		
	96,975	1,185	96,565	276,158	166,000	118,000
Total, 1940	102,250	3,219	113,402	219,112	176,000	70,000

METALLURGIC INDUSTRY

Of the State total ore and old tailings (98,160 tons), 66 percent was treated in concentrating mills, most of which used flotation; 25 percent was treated in amalgamation and cyanidation mills, with or without concentration equipment; and 9 percent was shipped crude to smelters. Ultimate recovery of 71 percent of the total lode gold was from the smelting of concentrates; 15 percent from direct smelting of ore; 11 percent as bullion from cyanidation of ore, old tailings, and concentrates; and 3 percent as bullion from amalgamation of ore. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

Data furnished by operators of gold and silver mills show that 6,526 pounds of 91-percent sodium cyanide were consumed in recovering 3,899 ounces of gold and 276 ounces of silver from 20,529 tons of ore, 250 tons of old tailings, and 10 tons of concentrates, and that 7 pounds of quicksilver were used in recovering 449 ounces of gold and 116 ounces of silver from 166 tons of ore.

Mine production of metals in Oregon in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ore amalgamated	1,440	971	222		
Ore, old tailings, and concentrates cyanided	22,802	4,056	513		
Concentrates smelted:					
Flotation	6,279	25,485	160,856	88,200	83,200
Gravity	96	111	470	24,000	800
Ore smelted	8,896	5,512	102,892	53,800	34,000
Total, lode mines		36,135	264,953	166,000	118,000
Total, placers		60,430	11,205		
		96,565	276,158	166,000	118,000
Total, 1940		113,402	219,112	176,000	70,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1941, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal		
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*
Baker	370		150	30	2	11	2
Grant	85		65	16	3	6	8
Harney	5		1				
Jackson	334		593	149			
Josephine	584		142	17	7	45	11
Lane	62		20	10			
	1,440		971	222	12	62	21
Total, 1940	4,416	305	2,819	556	31	124	139

CYANIDATION MILLS

County	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver
Baker	80		15	2			
Grant		50	5	1			
Jackson	98	510	58	62			
Josephine	21,439	625	3,978	448			
	21,617	1,185	4,056	513			
Total, 1940	16,520	3,119	4,001	403			
Grand total: 1941	23,057	1,185	5,027	735	12	62	21
1940	20,936	3,424	6,820	959	31	124	139

[1] Figures under "Ore" for cyanidation mills include both raw ore and concentrates cyanided, but not raw ore concentrated before cyanidation of concentrates

Mine production of metals from concentrating mills in Oregon in 1941, by counties, in terms of recovered metals

County	Ore	Concentrates smelted and recovered metal				
		Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	31,856	1,675	14,783	70,266	74,400	14,000
Grant	31,397	4,573	10,646	90,055	13,800	64,000
Jackson	1,377	43	102	648		6,000
Marion	500	72	3	336	24,000	
	65,130	6,363	25,534	161,305	112,200	84,000
Total, 1940	73,289	5,411	29,771	166,876	127,900	47,700

Gross metal content of concentrates produced from ores mined in Oregon in 1941, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	4,442	23,888	84,056	78,503	32,458	
Dry gold-silver	1,818	1,603	76,286	12,869	69,575	79,429
Copper	72	3	336	25,742		
Lead	43	102	648		7,262	
	6,375	25,596	161,326	117,114	109,295	79,429
Total, 1940	5,442	29,895	167,015	132,335	67,423	

Mine production of metals from Oregon concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	1,677	14,794	70,268	74,400	14,000
Grant	4,576	10,652	90,063	13,800	64,000
Jackson	43	102	648		6,000
Josephine	7	45	11		
Marion	72	3	336	24,000	
	6,375	25,596	161,326	112,200	84,000
Total, 1940	5,442	29,895	167,015	127,900	47,700

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead
Dry gold	4,442	23,888	84,056	75,900	24,200
Dry gold-silver	1,818	1,603	76,286	12,300	53,800
Copper	72	3	336	24,000	
Lead	43	102	648		6,000
	6,375	25,596	161,326	112,200	84,000

Gross metal content of Oregon crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	6,347	4,525	11,168	17,827	992
Dry and siliceous gold-silver	2,416	980	89,662	14,655	63,280
Dry and siliceous silver	4		178	19	100
Copper	129	7	1,884	25,764	564
	8,896	5,512	102,892	58,265	64,936
Total, 1940	8,225	5,097	38,258	52,810	35,635

Mine production of metals from Oregon crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	6,142	3,544	8,865	13,600	
Douglas	42	2	256	6,000	
Grant	256	800	3,260	2,200	
Jackson	6	156	41		
Jefferson	2,348	945	88,823	14,000	34,000
Josephine	73	50	26	16,000	
Lane	26		1,610	2,000	
Malheur	3	15	11		
	8,896	5,512	102,892	53,800	34,000
Total, 1940	8,225	5,097	38,258	48,100	22,300

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous gold	6,347	4,525	11,168	15,700	
Dry and siliceous gold-silver	2,416	980	89,662	14,100	34,000
Dry and siliceous silver	4		178		
Copper	129	7	1,884	24,000	
	8,896	5,512	102,892	53,800	34,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in Oregon in 1941, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Baker County:										
Baker	6	2	172	64	274	338	284			$12,032
Bull Run		1			1,632	1,632	197			57,260
Connor Creek		2			62	62	11			2,178
Cornucopia	3	2	31,855	14,783	100	14,883	70,314	74,400	14,000	580,483
Cracker Creek	3		5,435	3,093		3,093	8,408	12,000		115,650
Eagle Creek	1		10	8		8	1			281
Greenhorn [4]	1	6	6	8	2,747	2,755	422			96,725
Homestead	1	1	113	32	13	45	27			1,594
Mormon Basin [5]		4			174	174	31			6,112
Sparta	2		116	43		43	24			1,522
Sumpter		6			17,612	17,612	4,105			619,339
Upper Burnt River		4			234	234	42			8,220
Virtue	3	1	701	435	101	536	153	1,600		19,058
Weatherby	2	2	40	37	76	113	27			3,974
Coos County:										
Coos Bay		(6)			4	4				140
Coquille		(6)			38	38	4			1,333
Johnson Creek		(6)			58	58	10			2,037
Curry County:										
Gold Beach		(6)			14	14	3			492
Mule Creek		3			8	8				280
Ophir		(6)			4	4				140
Sixes		3			59	59	10			2,072
Douglas County: Riddle	1	9	42	2	143	145	270	6,000		5,975
Grant County:										
Canyon	3	7	55	47	3,399	3,446	675			121,090
Granite	5	5	31,441	11,231	8,404	19,635	94,282	13,800	64,000	759,546
Greenhorn [4]	3	1	184	199	12	211	930	2,200		8,306
Quartzburg	3	2	108	45	1,281	1,326	194			46,548
Susanville		4			2,203	2,203	405			77,393
Harney County:										
Idol City		1			294	294	97			10,359
Pueblo Mountain	1		5	1		1				35

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1941, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
Jackson County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Ashland	4	(6)	134	60	10	70	21			$2,465
Gold Hill	6	11	175	138	2,719	2,857	405			100,283
Greenback [7]	1	1	5	149	13	162	34			5,694
Jacksonville	3	2	480	66	1,175	1,241	190			43,570
Upper Applegate	9	19	55	387	10,872	11,259	1,606			395,207
Jefferson County: Ashwood	1		2,348	945		945	88,823	14,000	34,000	99,828
Josephine County:										
Galice	4	8	20,660	3,929	150	4,079	301			142,979
Grants Pass	5	6	650	91	764	855	115			30,007
Greenback [7]	5	12	477	83	982	1,065	174			37,399
Illinois River	(8)	5	(8)	(8)	225	[9] 225	[9] 31			[9] 7,897
Lower Applegate	2	1	4	19	24	43	10			1,512
Waldo	3	7	911	70	1,290	1,360	257	16,000		49,671
Lane County:										
Blue River	1		26				1,610	2,000		1,381
Bohemia	3	1	62	20	3	23	10			812
Malheur County:										
Malheur		6			227	227	31			7,967
Mormon Basin [5]	2	3	3	15	888	903	146			31,709
Marion County: North Santiam	1		500	3		3	336	24,000		3,176
Wallowa County: Snake River		(6)			7	7				245
Combined counties and districts [10]	3	5	1,387	132	2,135	2,267	1,132		6,000	80,492
Total Oregon	91	153	98,160	36,135	60,430	96,565	276,158	166,000	118,000	3,602,468

[1] Only those counties and districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 10 and their output included under "Combined counties and districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of total silver as follows: 264,953 ounces from lode mines and 11,205 ounces from placers.
[4] Greenhorn district lies in both Baker and Grant Counties.
[5] Mormon Basin district lies in both Baker and Malheur Counties.
[6] Output from a property not classed as a "mine."
[7] Greenback district lies in both Jackson and Josephine Counties.
[8] Included under "Combined counties and districts."
[9] Exclusive of lode output, which is included under "Combined counties and districts."
[10] Includes following districts: North Fork John Day in Grant County; Elk Creek in Jackson County; Illinois River (lode) in Josephine County; Columbia River in Morrow County; and Spanish Gulch in Wheeler County.

BAKER COUNTY [1]

Baker district.—The Midas mine in the Pocahontas section of the Baker district was worked by hydraulic mining during 1941; 198 ounces of gold and 21 ounces of silver were recovered from 6,585 cubic yards of gravel.

Bull Run district.—The Ferris Mining Co. operated a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on Bull Run Creek 6 miles southwest of Unity from January 1 until July 31, 1941; 485,270 cubic yards of gravel yielded 1,632 ounces of gold and 197 ounces of silver.

Cornucopia district.—The Cornucopia mine, operated by Cornucopia Gold Mines, continued to be the outstanding producer of lode gold, total gold, and copper in Oregon in 1941, although the company suspended operations October 31. Flotation of 30,800 tons of gold ore yielded 1,648 tons of gold concentrates containing 14,509 ounces of gold, 68,408 ounces of silver, 76,093 pounds of copper, and 21,744 pounds of lead; these concentrates and 8 tons of crude ore containing 6 ounces of gold, 38 ounces of silver, and 89 pounds of copper were shipped to a smelter. In terms of recovered metals, the mine supplied 40 percent of the lode gold produced in the State, 15 percent of the total gold, 25 percent of the silver, 45 percent of the copper, and 12 percent of the lead. The decline in production at this mine from its 1940 output was a major factor in the decreased gold and copper output in Oregon. A lessee shipped 1,046 tons of ore from the Simmons group for treatment at the Cornucopia flotation mill; the concentrates recovered were credited with a content of 264 ounces of gold and 1,840 ounces of silver.

Cracker Creek district.[2]—A smelter shipment of 217 tons of ore containing 236 ounces of gold, 64 ounces of silver, and 385 pounds of copper was made from the Argonaut mine in 1941. A lessee shipped 5,163 tons of smelting ore containing 2,828 ounces of gold, 7,776 ounces of silver, and 12,007 pounds of copper from the Columbia, Tabor Fraction, E & E, and North Pole mines.

Greenhorn district.—The Sunshine Mining Co. (Burnt River Division) installed a Yuba electric connected-bucket dredge with 4½-cubic foot buckets near Whitney and began operations October 21, 1941; treatment of 150,000 cubic yards of gravel yielded 391 ounces of gold and 80 ounces of silver. The Oroplata Mining Co. operated a dragline dredge on Pinus and Camp Creeks 3 miles north of Whitney.

Sumpter district.—Consuelo Oregon Mines operated a dragline dredge on McCully Fork. The Northwest Development Co. began 1941 with two dragline dredges operating in the Sumpter district, but only one dredge worked after February 28; 900,000 cubic yards of gravel yielded 5,701 ounces of gold and 1,324 ounces of silver. The Sumpter Valley Dredging Co., in 1941 again the largest producer of placer gold in Oregon, washed 3,376,514 cubic yards of gravel and recovered 9,178 ounces of gold and 1,923 ounces of silver; the dredge is of the connected-bucket electric-power type, with seventy-two 9-cubic foot buckets.

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[1] *See also* Pardee, J. T., Preliminary Geologic Map of the Sumpter Quadrangle, Oreg.. State of Oregon Department of Geology and Mineral Industries, 1941.

[2] Leaver, E. S., Woolf, J. A., and Towne, A. P., Progress Reports—Metallurgical Division. 46. Ore-Testing Studies (Primarily Precious Metals): Bureau of Mines Rept. of Investigations 3569, 1941, pp. 29–35.

Virtue district.—Lessees worked the Cliff mine during 1941; 65 tons of ore treated by amalgamation yielded 13 ounces of gold and 3 ounces of silver, and 279 tons of ore shipped to a smelter contained 190 ounces of gold, 97 ounces of silver, and 1,386 pounds of copper. During the first 5 months of the year, lessees on the Hidden Treasure mine shipped to a smelter 247 tons of ore containing 184 ounces of gold, 24 ounces of silver, and 468 pounds of copper; 80 tons of ore treated by cyanidation yielded 15 ounces of gold and 2 ounces of silver.

GRANT COUNTY [3, 4]

Canyon district.—On November 9, 1941, the Ferris Mining Co resumed operations with a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on the John Day River 3 miles northwest of John Day and continued until the end of the year; 130,370 yards of gravel yielded 683 ounces of gold and 72 ounces of silver. The Western Dredging Co. operated a connected-bucket dredge with seventy-two 6-cubic foot buckets from January 1 until October 4.

Granite district.—Porter & Co. operated a connected-bucket dredge with sixty-two 4½-cubic foot buckets on Granite, Clear, Olive, and Crane Creeks throughout 1941. The Intermountain Mining Co. abandoned dragline-dredge operations in the Granite district during the year. Bruce Dennis operated the Constitution mine; gold ore was treated in a 25-ton flotation plant, and gold concentrates and a small quantity of high-grade ore were shipped to a smelter. Cougar-Independence Lessees worked the Cougar Independence mine until September 1, when operations were suspended; gold ore was treated by flotation, and gold concentrates were shipped to a smelter. Rogers & McGinnis operated the La Bellevue mine from January 1 until November 15; gold-silver ore was treated in a 35-ton flotation plant, and gold-silver concentrates were shipped to a smelter. In addition to a substantial output of gold and silver, this operation led in the State in production of lead.

Greenhorn district.—Gold ore from the Morning mine, in that part of the Greenhorn district extending into Grant County from Baker County, was shipped to a smelter in 1941.

North Fork John Day district.—Ralph Davis, Inc., operated a dragline dredge, using a dragline excavator with a 3½-cubic yard bucket, at the North Fork placer from March 22 to December 24, 1941.

Quartzburg district.—The H. F. England Co. operated a dragline dredge with a dragline excavator, having a 1⅗₀-cubic yard bucket, on hydraulic tailings in Dixie Creek for 3 months in 1941; 150,000 cubic yards of gravel yielded 1,247 ounces of gold and 161 ounces of silver.

Susanville district.—The Timms Gold Dredging Co. operated its reconstructed connected-bucket dredge on the DeWitt ranch during 1941.

HARNEY COUNTY

Idol City district.—The H. F. England Co. operated a dragline dredge, moved from the Quartzburg district in Grant County to Trout Creek, for 2 months in 1941; 294 ounces of gold and 97 ounces of silver were recovered from old hydraulic tailings.

[3] Pardee, J. T., Work cited in footnote 1.

[4] *See also* State of Oregon Department of Geology and Mineral Industries, Oregon Metal Mines Handbook: Bull. 14-B, 1941, 157 pp

JACKSON COUNTY

Gold Hill district.—The Murphy-Murray Dredging Co. operated a connected-bucket dredge until September 22, 1941, when operations were discontinued; the dredge was dismantled and moved. Oregon Placer Mines, Inc., operated a dry-land dredge on Galls Creek from February 20 to July 6; 30,000 cubic yards of gravel yielded 198 ounces of gold and 38 ounces of silver. The Pleasant Creek Mining Corporation operated a connected-bucket dredge on Pleasant Creek.

Jacksonville district.—The Jackson Mining Co. operated a nonfloating washing plant with 4 Ainlay bowls, to which gravel was delivered by a 2-cubic yard dragline excavator, on the George Wendt ranch from May 15 to December 22, 1941.

Upper Applegate district.—Charles C. Stearns operated a dragline dredge on the Alaska of Oregon mine from January 8 to December 23, 1941. The B-H Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on Forest Creek; Stearns worked also on this property with a dragline dredge for a short time, and, in addition, conducted dragline dredging on the Herriot, Kubli, M. E. Dunlap, Walter W. Bell, and William Smith properties for short periods. The Crescent Pacific Mining Co. operated a dragline dredge, with a dragline excavator having a 1¾-cubic yard bucket, on the Fred Offenbacher, Matney, and Offenbacher ranches during 1941; 42,500 cubic yards of gravel at the Fred Offenbacher ranch yielded 244 ounces of gold and 33 ounces of silver, 88,825 cubic yards of gravel at the Matney ranch yielded 448 ounces of gold and 64 ounces of silver, and 455,770 cubic yards of gravel at the Offenbacher ranch yielded 1,490 ounces of gold and 195 ounces of silver. The Southern Oregon Mining Co. worked the McDonough and Taylor properties with a dragline dredge, using a dragline excavator with a 1¼-cubic yard bucket; 180,000 cubic yards of gravel at the McDonough ranch yielded 703 ounces of gold and 92 ounces of silver; and 65,700 cubic yards of gravel at the Taylor ranch yielded 70 ounces of gold and 9 ounces of silver. A lessee on the Sterling mine hydraulicked 34,375 yards of gravel and recovered 208 ounces of gold and 30 ounces of silver.

JEFFERSON COUNTY

Ashwood district.—The Oregon King Mines, Inc., shipped 2,348 tons of gold-silver ore containing 945 ounces of gold, 88,823 ounces of silver, 14,465 pounds of copper, and 63,046 pounds of lead from the Oregon King mine to a smelter in 1941. This mine was the leading producer of silver and the second-largest producer of lead in the State.

JOSEPHINE COUNTY

Galice district.—The Lewis Investment Co. worked the Benton mine throughout 1941 and was again the third-largest producer of lode gold in the State; the ore was treated in a 60-ton countercurrent-cyanidation plant.

Grants Pass district.—McGuire & Lyons operated a suction dredge on Rogue River near Grants Pass during 1941; 27,000 cubic yards of gravel yielded 191 ounces of gold and 17 ounces of silver. The Northern California Dredging Co. operated a dragline dredge, using a

dragline excavator with a 1¼-cubic yard bucket, on Jump-Off-Joe Creek for 4 months in 1941.

Greenback district.—Hydraulicking was carried on at the Blue Channel mine in 1941 from January 1 to June 1 and from November 15 to December 31. The Buckskin Mining Co. property on Wolf Creek was operated by hydraulicking for 5½ months. Hydraulicking was carried on at the Columbia mine.

Waldo district.—C. R. Stout hydraulicked at the Esterly mine in 1941 from January 1 to July 15 and from December 1 to 31 and recovered 433 ounces of gold and 24 ounces of silver from 150,000 cubic yards of gravel. The Atlas Gold Dredging Corporation operated a dragline dredge on Althouse Creek from January 1 to March 16; 255,178 cubic yards of gravel yielded 648 ounces of gold and 82 ounces of silver. Messenger and Johnson hydraulicked 62,000 cubic yards of gravel at the Plataurica mine on the Illinois River and recovered 108 ounces of gold and 7 ounces of silver.

MALHEUR COUNTY

Malheur district.—Pacific Placers operated a dry-land dredge near Brogan during 1941.

Mormon Basin district.—Mormon Basin Placers treated gravel in a stationary washing plant at Colt Bros. Placers and recovered 318 ounces of gold and 46 ounces of silver from 13,000 cubic yards of gravel. Whitney and Boydstun worked the Lone Eagle mine with a caterpillar scraper and washing plant; 60,000 cubic yards of gravel yielded 353 ounces of gold and 62 ounces of silver. The Gold Flower Mining Co. operated a dragline excavator and portable nonfloating washing plant.

OTHER COUNTIES

Small outputs in 1941 were reported from Coos, Curry, Douglas, Lane, Marion, Morrow, Wallowa, and Wheeler Counties.

Details of production by counties and districts are given in the preceding table.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By Chas. W. Henderson and S. A. Gustavson

SUMMARY OUTLINE

For many years the principal mineral industry of South Dakota has been lode gold mining, with subsidiary silver. Such minor minerals as columbo-tantalite, tin, and lithium minerals have been produced, and at present there is a project for developing a large low-grade manganese deposit. The gold and minor mineral area of the State is included in Custer, Lawrence, and Pennington Counties in the mountain group known as the Black Hills. A notable exception is the extensive low-grade manganese deposit near Chamberlain, Brule County, which in 1941–42 was being developed and processed by the Federal Bureau of Mines. The total production of recovered gold in South Dakota in 1941—600,637 fine ounces valued at $21,022,295, a 2-percent increase over 1940—has been exceeded only by the peak output of 618,536 ounces valued at $21,648,760 in 1939. Recovered silver in 1941, all a byproduct of gold mining, was 170,771 fine ounces valued at $121,437. No copper or lead was recovered in 1941.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35 00	$0.7735	$0 121	$0 059	$0 065
1938	35.00	[4] 646+	.098	046	.048
1939	35 00	[5] 678+	104	047	052
1940	35 00	[6] 711+	.113	050	.063
1941	35 00	[6].711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20 671835) per fine ounce.

[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938-41 Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

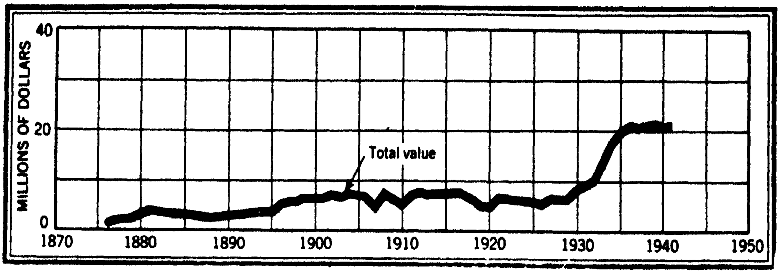

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876-1941.

Mine production of gold, silver, copper, and lead in South Dakota, 1937–41, and total, 1876–1941, in terms of recovered metals [1]

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	14	73	1,597,178	581,544	$20,354,040	139,638	$108,010
1938	11	71	1,586,181	594,847	20,819,645	162,295	104,918
1939	18	80	1,632,778	618,536	21,648,760	167,584	113,754
1940	11	81	1,667,370	586,662	20,533,170	175,514	124,810
1941	10	41	1,711,744	600,637	21,022,295	170,771	121,437
1876-1941			(2)	20,037,943	482,925,214	9,346,276	6,648,628

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1937					$20,462,050
1938					20,924,563
1939					21,762,514
1940	12,000	$1,356	14,000	$700	20,660,036
1941					21,143,732
1876-1941	[3] 104	35,954	[3] 295	35,520	489,645,316

[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. 1, p. 42; Mineral Resources, 1922, pt. 1, p. 194, and subsequent volumes of Mineral Resources and Minerals Yearbook.
[2] Figures not available.
[3] Short tons.

Gold and silver produced at placer mines in South Dakota, 1937–41, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1937	1,010 60	$35,371	75	$58	$35,429
1938	1,069 00	37,415	82	53	37,468
1939	622.00	21,770	47	32	21,802
1940	229 00	8,015	21	15	8,030
1941	93 00	3,255	7	5	3,260

MINE PRODUCTION BY COUNTIES

Mine production of gold and silver in South Dakota in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)		Total value
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	
Custer		7	27	$945	1	$1	$946
Lawrence	6	13	596,109	20,863,815	169,891	120,811	20,984,626
Pennington	4	21	4,501	157,535	879	625	158,160
	10	41	600,637	21,022,295	170,771	121,437	21,143,732

MINING AND METALLURGIC INDUSTRY

Producers of lode gold and silver in South Dakota in 1941 mined and sold or treated 1,711,744 short tons of ore yielding, in recovered metals, 600,544 fine ounces of gold and 170,764 fine ounces of silver. Methods of treatment were as follows: 1,499,988 tons treated by amalgamation followed by cyanidation of sands and slimes; 205,356 tons by cyanidation only (36,677 tons of which was first roasted and about one-fourth of 134,985 tons also first roasted); 3,725 tons by jigging, amalgamation of the jig concentrates, and flotation of the remaining pulp (concentrates carrying gold and silver shipped to smelters); 100 tons by amalgamation only; 2,370 tons by amalgamation with flotation of tailing; 31,894 tons (included in 205,356 tons above) by countercurrent-decantation cyanidation with jig in ball-mill circuit (gold concentrates shipped to smelter); 200 tons by concentration; and 5 tons of crude ore shipped direct to the Omaha (Nebr.) refinery Operating details at both lode and placer mines are given in the following review by counties.

METALLURGIC RECOVERY

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1937–41

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1937	1,414,772	329,975.10	66,640	10,178
1938	1,430,391	328,044.50	62,602	7,744
1939	1,461,283	336,424.93	64,710	9,221
1940	1,479,905	313,964.15	60,254	4,997
1941	1,506,183	328,166.44	62,423	6,537

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1937–41

Year	Material treated				Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Crude ore	Concentrates	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1937	182,406		1,394,252	1,576,658	249,980.70	72,833	786,072
1938	155,667		1,416,899	1,572,566	262,913.21	98,777	860,762
1939	170,270	[2] 61	1,443,548	1,613,879	279,889.77	102,317	887,888
1940	187,360		1,432,244	1,619,604	269,518.82	111,607	883,849
1941	205,356		1,499,000	1,704,356	270,989.89	106,437	[3] 903,680

[1] In terms of 96- to 98-percent strength.
[2] From 1,143 tons of ore treated by flotation
[3] Actually 1,755,590 pounds of calcium cyanide (48- to 49-percent strength) and 28,445 pounds of sodium cyanide (91-percent strength); all reduced to equivalent of 96- to 98-percent strength to conform with earlier use of figures for high-strength NaCN and KCN.

REVIEW BY COUNTIES

CUSTER COUNTY

Small, hand-method, gold placering was done on seven properties, chiefly on French Creek, and constituted the only operations in Custer County in 1941. The gold recovered was sold either to local buyers or direct to the United States Mint at Denver, Colo. A large proportion of the placer ground in the county has been worked out and this, together with the fact that more jobs in other occupations are available, accounts for the small production of gold from the county.

LAWRENCE COUNTY

Homestake mine.—The Homestake mine has been an almost continuous producer of gold and silver since 1876 and has been operated by the Homestake Mining Co. since 1877. The company at first owned only the Homestake and Golden Star claims but has since acquired numerous others which, with the first two, have been consolidated into one group called the Homestake mine. The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1941, says—

Operations during 1941 were substantially normal in all departments. Ore production from the mine was 1,499,988 tons which is an increase of 4.62 percent over that for 1940. The gross income for gold and silver produced was 2.70 percent higher than in 1940. The average realization per ton was $13.02 as compared to $13.26 in 1940.

Operating expenses exclusive of taxes were slightly higher than in 1940. Total taxes were $4,160,334.61, which is $570,990.29 more than in 1940.

There are 358,784 tons of broken ore remaining in shrinkage stopes.

The reserve of developed ore is 19,393,300 tons. As in previous reports this includes the broken ore. Of the total reserve 9,600,191 tons are in the ledge developed in recent years and 9,793,109 tons are in the main ledges. Production from the new ledge during 1941 was 310,813 tons or 20.72 percent of the total mined.

Yates shaft construction is practically completed. The shaft was completed to the 4,100-foot level late in December and sinking below that level is in progress. Ore hoisting at the Yates shaft began on October 1 and the handling of men and materials on November 10. All parts of this new plant are operating satisfactorily. The winze from the 4,100-foot level was deepened from the 4,700-foot evel to the 5,000-foot level and drifting on the 5,000-foot level was begun.

Ore milled, receipts, and dividends, Homestake mine, 1937–41 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1937	1,394,773	$19,304,076.45	$13.8403	$9,041,760
1938	1,377,314	19,284,459.67	14.0015	9,041,760
1939	1,400,015	19,922,964.60	14.2300	9,041,760
1940	1,433,737	19,014,767.73	13.2624	9,041,760
1941	1,499,988	19,529,080.70	13.0195	9,041,760

[1] From 1876 to 1941, inclusive, this mine yielded bullion and concentrates that brought a net return of $418,541,828 and paid $142,271,002 in dividends

The system of mining used at the Homestake mine has been described briefly as follows:[1]

The ore body is first cut by a series of stopes each extending for 60 feet along the strike and from wall to wall of the deposit—a distance which may be as great as

[1] Lincoln, Francis Church, Miser, Walter G., and Cummings, Joseph B., The Mining Industry of South Dakota: South Dakota Sch. Mines Bull. 17, February 1937, pp. 12–14.

400 feet. Pillars of ore 42 feet in thickness separate the 60-foot stopes. A stope is started by making a cut entirely across its bottom. A timbered gangway provided with chute gates is next constructed across the floor of the cut and waste filling is introduced around it. The stope is then carried upward by shrinkage stoping to within about 25 feet of the level above. The interval between levels is 100 feet in the upper part of the mine and 150 feet in the lower. During shrinkage stoping, the miners stand upon the broken ore, enough being drawn off regularly through the chute gates into the gangway to keep the ore away from the back and provide room for the miners to work. When shrinkage stoping is completed, the broken ore remaining in the stope is all drawn off, and the stope is filled with waste rock or mill tailings. The crowns of the stopes and the pillars between them are later mined by the square-set timbering system, the square sets being filled with waste.

Since 1932 sand fill (tailings from the sand plants) has been used to supplement the coarse waste fill.

The ore drops from the chutes into ore cars pulled by compressed-air locomotives and is taken to the shafts for hoisting. Primary crushing of the ore is done at the shafts. From the shafts the ore is moved by a rail tramway to the South mill, which has a capacity of 3,900 tons per 24 hours. Here the ore is reduced further by stamps and fed to rod mills in closed circuit with Clark-Todd amalgamators for primary grindings and to ball mills and pebble mills in closed circuit with Clark-Todd amalgamators for secondary grinding. The copper amalgamation plates, for many years an integral part of the mill equipment, gradually have been replaced by the Clark-Todd amalgamators. Classification is done partly in the South mill and is finished in cyanide sand plant No. 1 and cyanide sand plant No. 3. In plant No. 3 part of the sand tailings from the South mill are classified and ground further in ball mills in closed circuit with Clark-Todd amalgamators. The sands are treated by cyanide leaching, and the slimes are thickened and sent to the slime plant at Deadwood for further treatment. In plant No. 1 a partly classified sand portion of the tailings from the South mill is separated by cone classification into sand and slime fractions. In this plant the sands are leached, and the solutions from both this plant and plant No. 3 are precipitated. Slimes are piped to the slime plant at Deadwood, which accomplishes cyanidation of the slimes from both plants. Precipitation is by the Merrill-Crowe process. Silver is parted from the gold in the company refinery, and virtually pure metals are shipped to the mint.

The Homestake mine has been developed through shafts; the newest and deepest (4,100 feet) is the Yates which, to date, has cost over $3,000,000. In 1941 development work in the mine consisted of sinking 700 feet of shaft, driving 28,074 feet of drifts and crosscuts and 10,878 feet of raises, and performing 45,656 feet of diamond drilling.

Other mines.—The second-largest producer of gold and silver in South Dakota in 1941 was the Bald Mountain Mining Co. The company operated continuously its consolidated group of mines and 370-ton (rated 350 tons in 1940) all-sliming countercurrent-cyanidation plant at Trojan. Ore was produced in 1941 from the Portland, Two Johns, Dakota, Trojan, Clinton, and Empire claims. Development work done on these claims in 1941 totaled 2,695 feet of drifts and 630 feet of raises. The mill treated 134,985 tons of dry gold ore, from which 27,322 fine ounces of gold and 48,937 fine ounces of silver were recovered. Five tons of high-grade ore, containing 98 fine ounces of gold and 1,521 fine ounces of silver, were shipped direct to the Omaha (Nebr.) refinery. About 25 percent of the ore produced was sulfide

(locally known as "blue ore"), and 75 percent was oxide (locally known as "brown ore"). After primary crushing the sulfide ore was roasted in a 110-ton gas-fired rotary hearth furnace, then mixed with the oxide ore and cyanided. The net return from metals produced in 1941 after transportation and mint and smelter charges were deducted was $989,945.

The Canyon Corporation operated its Maitland group of claims and 120-ton (rated 100 tons in 1940) roast-cyanide mill continuously, treating 36,677 tons of ore which yielded 11,256 fine ounces of gold and 1,056 fine ounces of silver. Development work in the mine consisted of 2,754 feet of prospecting drifts, 2,257 feet of development drifts, and 4,354 feet of diamond drilling.

The Gilt Edge Mines, Inc., properties in the Bear Butte district were inoperative, except that clean-up in the mill and final settlement of product mined in 1940 carried over into 1941.

The Frerichs Mining Co. operated its mine and 50-ton flotation-cyanidation mill during January and February 1941, making test runs to try out equipment and determine best extraction. About 1,800 tons of ore were treated, which yielded 91 fine ounces of gold and 66 fine ounces of silver.

The Belle Eldridge Gold Mines, Inc., did some development work on its property in the Whitewood district and made repairs and installed some new equipment in the company mill.

Placers active in Lawrence County included two operations in the Bear Butte district, one in the Custer Peak, one in the Portland or Bald Mountain, one in the Rawlings, one in the Two Bit, and seven in the Whitewood district. All were small hand-sluicing and panning operations and produced a total of only 35 fine ounces of gold and 3 fine ounces of silver.

PENNINGTON COUNTY

The Holy Terror Mining Co. operated its mine and 100-ton cyanidation plant in the Keystone district continuously, treating 31,894 tons of dry gold ore. The mill process is countercurrent-decantation cyanidation, with a jig in the ball-mill circuit. Part of the jig concentrates was shipped to the Helena (Mont.) smelter. The gold-silver bullion was shipped to the Denver Mint. In the mine a development program was started to open up a level 200 feet below the 1941 workings.

In the Hill City district, the Gold Mountain Mining Co. operated part time its mill and the Gold Lode group of claims.

Two other small lode operations in Pennington County—one in the Hill City district and the other in the Hornblende district—treated a few tons of ore in small amalgamation mills; each recovered less than 2 fine ounces of gold.

Twenty-one placers in the county, all small hand-sluicing or panning operations, yielded a total of 31 fine ounces of gold and 3 fine ounces of silver in 1941. Operations were chiefly on Castle Creek in the Castle Creek district, Battle Creek in the Keystone district, and Rapid Creek in the Rapid Creek district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson and S. A. Gustavson

SUMMARY OUTLINE

Silver was found in Texas in 1880 at the Presidio mine at Shafter, Presidio County, but it was not until 1885 that shipments of bullion were begun. From 1885 through 1941 this mine has been by far the outstanding producer of the State—chiefly of silver but also of gold and lead. Another early producer was the Hazel mine in Culberson County. The American Metal Co. of Texas continued to operate the Shafter mine and 400-ton cyanidation mill in 1941 and made a slightly decreased tonnage output containing less silver to the ton than in 1940. About 200 tons of silver smelting ore (carrying some copper) from the Hazel mine and 18 tons of silver ore from the Needle Peak mine were shipped to the El Paso smelter. Of interest in 1941 was the shipment of 6 tons of copper ore from an open-cut on the Bob Cat location 10 miles south and 6 miles east of Quanah, Hardeman County, where copper ore has been reported for many years. A car of silver smelting ore, carrying some copper, was shipped from the Black Shaft mine near Allamoore, Hudspeth County, to the El Paso smelter. Smelting lead-silver ore, carrying some copper, was shipped from the Puerto Rico mine near Sierra Blanca, Hudspeth County, to El Paso.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35 00	$0. 7735	$0. 121	$0. 059	$0. 065
1938	35 00	[4] .646+	. 098	. 046	. 048
1939	35. 00	[5] .678+	. 104	. 047	. 052
1940	35 00	[6] . 711+	. 113	. 050	. 063
1941	35. 00	[6] . 711+	. 118	. 057	. 075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1937. Yearly average weighted Treasury buying price for newly mined silver, 1938–41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1937 to 1941, as well as the total metal production from 1885 to 1941.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1937–41, and total, 1885–1941, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1937	120,145	562	$19,670	1,325,660	$1,025,398
1938	131,002	439	15,365	1,433,008	926,389
1939	141,795	324	11,340	1,341,945	910,896
1940	146,936	312	10,920	1,326,150	943,040
1941	140,818	306	10,710	1,096,027	779,397
1885–1941	(1)	8,041	215,380	32,513,756	22,874,293

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	320,000	$38,720	790,000	$46,610			$1,130,398
1938	32,000	3,136	684,000	31,464			976,354
1939	68,000	7,072	454,000	21,338			950,646
1940	60,000	6,780	410,000	20,500			981,240
1941	12,000	1,416	372,000	21,204			812,727
1885–1941	[2] 956	278,153	[2] 4,594	463,245	[2] 744	$106,491	23,937,562

[1] Figures not available. [2] Short tons.

Mine production of gold, silver, copper, and lead in Texas in 1941, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Culberson	2	234		1,918	8,900	
Hardeman	1	6		1	400	
Hudspeth	4	73	2	276	2,700	3,100
Presidio	2	140,505	304	1,093,832		368,900
	9	140,818	306	1,096,027	12,000	372,000
Total, 1940	6	146,936	312	1,326,150	60,000	410,000

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Texas in 1941, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous silver ore	4	140,739	304	1,095,750	8,900	368,900
Copper ore	2	58		22	3,000	
Lead ore	3	21	2	255	100	3,100
	9	140,818	306	1,096,027	12,000	372,000
Total, 1940	6	146,936	312	1,326,150	60,000	410,000

SMELTING AND REFINING PLANTS IN TEXAS

In 1941 two zinc retort smelters, one copper smelter, one lead smelter, one antimony smelter, one tin smelter, and one electrolytic copper refinery were operating in Texas; and an electrolytic zinc refinery was under construction. The two zinc retort smelters and the electrolytic copper refinery were operated virtually at capacity throughout the year. While the copper and lead smelters were run somewhat under capacity, owing to lack of domestic ores and Mexican ores, advantage was taken of the situation to make improvements, repairs, and additions to both plants.

The American Smelting & Refining Co. continued to operate its copper and lead smelters at El Paso in 1941, treating ores purchased from operators in Arizona, California, New Mexico, and Texas and in Mexico. Also, ores from Canada, South America, Africa, and many other foreign countries were sent to the smelters at El Paso after their original destinations had fallen into enemy hands, and other ores captured by the British. Additional roasting facilities, other new equipment, and general repairs and improvements were made on both the lead and copper smelters during the year. In addition to the lead and copper furnaces the El Paso plant contains a unit for the recovery of arsenic.

The American Smelting & Refining Co. gas-retort zinc smelter at Amarillo was operated continuously at capacity throughout the year, treating zinc concentrates and some high-grade zinc ores purchased from operators in Arizona, Colorado, Nevada, New Mexico, and Utah, and in Mexico. Zinc concentrates from Newfoundland were treated under bond. Three blocks, each of 800-ton monthly capacity, were added to the plant early in the year, supplementing the five blocks already in use and increasing the capacity 60 percent. Roasting equipment at the plant was inadequate to handle the added retort capacity and necessitated preliminary roasting of Mexican ores at the company El Paso plant.

The Machovec smelter of the American Zinc Co. of Illinois at Dumas, Tex., was operated at capacity throughout the year on zinc concentrates from operators in New Mexico and in Mexico, and zinc concentrates from Newfoundland were treated under bond. Additions to the plant were made, increasing capacity 100 percent since it was again placed in operation in February 1940. The plant is leased from the Illinois Zinc Co.

The Nichols electrolytic copper refinery at El Paso, a unit of the Phelps Dodge Corporation, continued to refine copper anodes produced at corporation smelters in Arizona. The plant was operated virtually at capacity throughout the year.

MINES REVIEW BY COUNTIES

Culberson County.—The Hazel mine 14 miles northwest of Van Horn was operated by A. P. Williams under lease until March 20, 1941, when his lease expired. The mine was then operated by J. P. Witherspoon, with A. P. Williams acting as mine superintendent. In 1941 silver ore totaling 216 tons and containing 1,815 ounces of silver, 9,141 pounds of copper, and 433 pounds of zinc was shipped to the El Paso smelter. A small lot of 18 tons of dry silver ore containing 103 ounces

of silver was shipped also from Culberson County to the El Paso smelter.

Hardeman County.—A 6-ton lot of copper ore containing 440 pounds of copper was shipped to the El Paso smelter.

Hudspeth County.—The Black Shaft mine 8 miles south of Allamoore was operated 11 months during 1941 by A. P. Williams. Copper ore totaling 52 tons and containing 21 ounces of silver and 2,641 pounds of copper was shipped to the El Paso smelter. Three small lots of lead ore totaling 21 tons were shipped from Sierra Blanca to the El Paso smelter, mostly from the Puerto Rico mine.

Presidio County.—The American Metal Co. of Texas operated its Presidio property continuously in 1941; the quantity of ore treated was 140,503 tons compared with 144,558 tons in 1940. The mine is developed by two vertical shafts, one 400 and one 700 feet deep; three underground subshafts, one 100, one 250, and one 450 feet deep; and other openings reported as totaling 75 miles of underground workings. Development work in 1941 comprised 303 feet of shaft, 8,532 feet of drifts, and 27,808 feet of diamond drilling. The minerals contained in the ore are argentite, cerargyrite, galena, anglesite, and cerussite. The ore is transported 1¼ miles by rail and aerial tramways from the shafts to the 400-ton mill (average per day treated in 1941, 387 tons). In 1941 the mill produced 940,967 ounces of silver and 285 ounces of gold in cyanide precipitates, and 439 tons of table concentrates containing 152,781 ounces of silver, 19 ounces of gold, and 350,277 pounds of lead. The cyanide precipitates carried 26,065 pounds of lead dissolved by the cyanide, an unusual phenomenon. The concentrates and precipitates were shipped to the Carteret (N. J.) smelter.

Production of silver from the Presidio mine,[1] 1885–1941 [2]

Period	Mill heads treated (short tons)	Silver content of mill heads (ounces)		Recovery of silver	
		Per ton	Total	Percent	Ounces
1885–1912	450,000	25 84	11,628,000	81.68	9,497,750
1913–26	720,000	12 00	8,640,000	83 66	7,228,224
1927	48,190	22 87	1,102,105	91 41	1,007,434
1928	57,475	23 17	1,331,696	91 04	1,212,340
1929	54,644	19 74	1,078,673	90 30	974,049
Total, 1885–1929	1,330,309	17 88	23,780,474	83.77	19,919,797
1930	24,985	16 09	401,926	88.79	356,854
1934	46,653	19 70	919,064	91 39	839,936
1935	70,166	15.87	1,113,686	87.84	978,303
1936	98,499	14.41	1,419,371	87.48	1,241,605
1937	110,220	12 76	1,406,825	86.79	1,220,921
1938	127,574	12.76	1,627,844	84 72	1,379,187
1939	138,934	11.24	1,561,618	83 49	1,303,748
1940	144,558	10.55	1,525,087	84.90	1,294,803
1941	140,503	9.39	1,319,323	82 90	1,093,748
Total, 1885–1941	2,232,401	15.71	35,075,218	84.47	29,628,902

[1] Howbert, Van Dyne, and Gray, F. E., Milling Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 368, 1930, 20 pp.
Howbert, Van Dyne, and Bosustow, Richard, Mining Methods and Costs at Presidio Mine of the American Metal Co. of Texas Am. Inst. Min. and Met. Eng. Tech. Pub. 334, 1930, 15 pp.
Stem, D. E., Milling Methods and Costs at the Presidio Mine: Arizona Min. Jour., vol. 24, No. 22, April 15, 1941, pp. 3–5.

[2] No production in 1931, 1932, and 1933.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

SUMMARY

Utah mines produced gold, silver, copper, lead, and zinc in 1941 valued at $97,796,623, in terms of recovered metals. This value, compared with $86,585,499 in 1940, represents a 13-percent gain, which was due almost entirely to the increased output of recovered copper. The quantity of gold was virtually the same as in 1940; that of silver, lead, and zinc decreased, although the total value of both lead and zinc increased. The slight gain in gold and by far the largest part of the gain in copper output can be credited to the Bingham district and resulted from the outstanding efforts of the Utah Copper Co. The Park City region showed gains in production of gold and copper only, and the Tintic district made gains in output of lead and zinc. Tooele County reported a loss in output of each metal except zinc, which increased owing to the output from the Tooele slag-fuming plant.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052
1940	35.00	[6].711+	.113	.050	.063
1941	35.00	[6].711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver; 1938–41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1937–41, and total, 1864–1941, in terms of recovered metals

Year	Mines producing: Lode	Mines producing: Placer	Ore (short tons)	Gold (lode and placer): Fine ounces	Gold (lode and placer): Value	Silver (lode and placer): Fine ounces	Silver (lode and placer): Value
1937	189	14	24,578,275	322,759	$11,296,565	12,869,117	$9,954,262
1938	183	22	13,248,660	200,630	7,022,050	9,682,732	6,259,544
1939	175	11	21,094,097	277,751	9,721,285	10,758,657	7,302,846
1940	191	21	27,939,346	355,494	12,442,290	12,172,299	8,655,857
1941	167	12	31,952,817	356,501	12,477,535	11,395,485	8,103,456
1864–1941			(1)	9,058,229	217,263,055	681,300,151	496,755,268

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1937	411,988,000	$49,850,548	178,916,000	$10,556,044	96,002,000	$6,240,130	$87,897,549
1938	216,252,000	21,192,696	131,314,000	6,040,444	67,316,000	3,231,168	43,745,902
1939	343,780,000	35,753,120	135,268,000	6,357,596	69,052,000	3,590,704	62,725,551
1940	463,728,000	52,401,264	151,376,000	7,568,800	87,576,000	5,517,288	86,585,499
1941	533,676,000	62,973,768	139,202,000	7,934,514	84,098,000	6,307,350	97,796,623
1864–1941	[2] 3,646,526	1,039,489,341	[2] 4,157,806	447,711,842	[2] 789,656	95,842,627	2,297,062,133

[1] 1864–1901: Figures not available; 1902–41: 421,365,983 tons produced.
[2] Short tons.

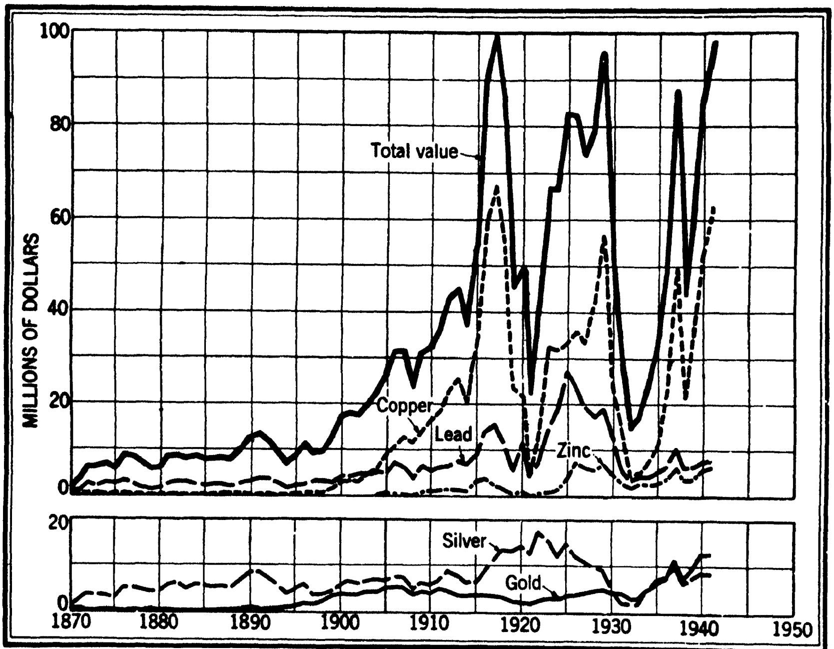

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Utah, 1870–1941.

Gold.—The output of recoverable gold in Utah increased 1,007 ounces in 1941 from 1940. Copper ore yielded 68 percent of the total gold and siliceous ore 16 percent; the remainder came from zinc-lead ore, lead ore, lead-copper ore, zinc ore, zinc-lead-copper ore, and slag

and from placers. The placer output was negligible. Gold recovered from ore of all classes treated in concentrating mills comprised 80 percent of the State total, from crude ore shipped direct to smelters nearly 15 percent, and from ore treated by amalgamation and cyanidation and from placers 5 percent. The Bingham (West Mountain) district produced 77 percent of the State gold and showed a gain of 18,561 ounces. The Park City region produced 2,447 ounces more gold than in 1940, owing to the output of the New Park Mining Co. Gold produced from the Tintic district decreased sharply, owing chiefly to the decline at the Tintic Bullion and Centennial-Beck & Victoria mines, and gold output from Tooele County decreased 3,481 ounces. The Utah Copper Co., which supplied over 67 percent of the State gold, was followed by the group of properties at Mercur under control of Snyder Mines, Inc., and the United States & Lark, Mayflower, and Tintic Bullion mines; these five mines produced 88 percent of the total gold output of the State.

Silver.—Silver recovered from Utah ore totaled 11,395,485 ounces in 1941, a decrease of 776,814 ounces from 1940, owing primarily to the lower output of siliceous ore. In 1941 zinc-lead, lead-copper, and zinc-lead-copper ore yielded 51 percent of the State total silver, siliceous ore 20 percent, copper ore 20 percent, and lead ore nearly 9 percent. Bingham was again the largest silver-producing district (supplying 43 percent of the State total), followed by the Park City region, the Tintic district, and Tooele County. Ore concentrated yielded 70 percent of the State silver, and ore shipped crude to smelters nearly all the remainder. The Utah Copper Co. was again the largest producer, followed by the United States & Lark, Tintic Standard, Silver King Coalition, the Park City Consolidated properties, the New Park Mining Co. property, the Park Utah Consolidated Mines groups, and the Chief Consolidated properties; these eight properties produced 82 percent of the silver output of Utah in 1941.

Copper.—The output of recoverable copper in Utah during 1941 was 533.676,000 pounds, by far the greatest production in the history of the State; the previous high year was 1940, when the output was 463,728,000 pounds. The Utah Copper Co. exceeded its former high record set in 1940; its open-cut mine at Bingham produced about 68,000,000 tons of ore and waste at a ratio of about 1¼ tons of waste to 1 ton of ore. The company mills at Magna and Arthur treated ore at a combined rate of over 83,000 tons a day and showed high recoveries in copper; their rated capacity is approximately 68,000 tons a day. Copper ore mined in Utah totaled 30,444,402 tons in 1941 compared with 26,301,745 in 1940. Copper ore and mine-water precipitates yielded 99 percent of the State copper. Other producers of copper in Utah included the Ohio Copper Co. and the United States & Lark properties in the Bingham district and the Tintic Standard properties in the Tintic district.

During the first 4 months of 1942, Utah mines were producing at a rate which indicated that even the all-time high production of 1941 would be exceeded.

Lead.—The output of recovered lead in Utah was 139,202,000 pounds in 1941, a decline of 12,174,000 pounds from 1940. The Bingham district continued to be the largest lead-producing area in the State, although production declined 6,689,100 pounds from 1940; most of the output came from the United States & Lark properties. The

Park City region produced about the same quantity of lead as in 1940, but the average grade of the ore treated decreased slightly in 1941; the two leading producers of the district were the Silver King Coalition Mines Co. and the Park Utah Consolidated Mines Co. (including Daly), which together produced 195,291 tons of ore yielding 30,854,000 pounds of lead. The output from the Tintic district showed a gain, owing chiefly to increased production at the Tintic Standard mine, from which large quantities of siliceous ore and dump material were shipped direct to a smelter in 1941 for fluxing purposes. Output from the Calumet and Hidden Treasure mines in Tooele County decreased from 1940. The principal lead-producing mines in Utah in 1941 were the United States & Lark, Park Utah Consolidated (including Daly), Silver King Coalition, Tintic Standard, Calumet, New Park mines, and Chief Consolidated; these seven properties produced 81 percent of the State total lead.

Output during the first 3 months of 1942 indicates that lead is being produced at a rate that will result in a material gain over 1941.

Zinc.—The output of recoverable zinc in Utah during 1941 decreased 4 percent from 1940. The chief zinc-producing areas—the West Mountain district and the Park City region—each reported a loss, as both tonnage and grade were lower than in 1940. Zinc was recovered finally from zinc-lead ore treated at four selective-flotation mills, from zinc-lead-copper ore treated at two of the flotation mills, from the fuming of zinc-lead slag at Tooele, and from crude zinc and zinc-lead ore shipped direct to smelters. The United States & Lark property in the Bingham district was again the largest producer of zinc in the State, followed by the Park Utah Consolidated (including Daly) and Silver King Coalition properties in the Park City region, the Calumet property in Tooele County, and the New Park property in the Park City region; these five mines supplied 84 percent of the State zinc output in 1941.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1941, by counties, in terms of recovered metals

County	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Beaver	16		4,387	269	$9,415	31,455	$22,368
Box Elder	2		257	60	2,100	10,762	7,653
Garfield		2		4	140		
Grand	1	4	5	252	8,820	73	52
Iron	3		676	37	1,295	924	657
Juab	27		176,170	10,442	365,470	871,771	619,926
Millard	3	1	1,128	400	14,000	315	224
Morgan	2		17			21	15
Piute	3		2,121	929	32,515	8,543	6,075
Salt Lake	27		30,867,826	275,368	9,637,880	4,880,146	3,470,326
San Juan		2		18	630		
Sevier	3		35	15	525	329	234
Summit	8		223,560	4,572	160,020	1,818,149	1,292,906
Tooele	44		386,282	34,872	1,220,520	456,629	324,714
Uintah	1	3	2	334	11,690	34	24
Utah	21		176,299	13,752	481,320	1,863,270	1,324,992
Wasatch	4		114,035	15,175	531,125	1,453,050	1,033,280
Washington	2		17	2	70	14	10
	167	12	31,952,817	[1] 356,501	12,477,535	11,395,485	8,103,456
Total, 1940	191	21	27,939,346	[2] 355,494	12,442,290	12,172,299	8,655,857

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1941, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	63,600	$7,505	324,000	$18,468	705,000	$52,875	$110,631
Box Elder	900	106	2,000	114			9,973
Garfield							140
Grand							8,872
Iron	800	94	55,700	3,175			5,221
Juab	672,000	79,296	7,162,000	408,234	1,554,000	116,550	1,589,476
Millard	700	83	1,900	108			14,415
Morgan			7,300	416			431
Piute	900	106	23,000	1,311			40,007
Salt Lake	529,477,000	62,478,286	69,316,000	3,951,012	41,048,000	3,078,600	82,616,104
San Juan							630
Sevier			400	23	10,000	750	1,532
Summit	825,000	97,350	31,308,000	1,784,556	26,355,000	1,976,625	5,311,457
Tooele	505,000	59,590	12,155,700	692,875	7,936,000	595,200	2,892,899
Uintah	100	12					11,726
Utah	1,448,000	170,864	11,966,000	682,062	492,000	36,900	2,696,138
Wasatch	682,000	80,476	6,880,000	392,160	5,998,000	449,850	2,486,891
Washington							80
	533,676,000	62,973,768	139,202,000	7,934,514	84,098,000	6,307,350	97,796,623
Total, 1940	463,728,000	52,401,264	151,376,000	7,568,800	87,576,000	5,517,288	86,585,499

[1] Includes 629 ounces of placer gold distributed as follows: Garfield County, 4 ounces; Grand County, 252 ounces; Millard County, 21 ounces; San Juan County, 18 ounces; and Uintah County, 334 ounces.
[2] Includes 275 ounces of placer gold distributed as follows: Garfield County, 1 ounce; Grand County, 82 ounces; Millard County, 74 ounces; San Juan County, 35 ounces; and Uintah County, 83 ounces.

MINING INDUSTRY

Copper ore produced in Utah in 1941 (predominantly from the Bingham district) represented 95 percent of the total tonnage of ore of all classes. The Utah Copper Co., operating the open-pit mine at Bingham, began 1941 with a monthly output of about 42,000,000 pounds of copper, which had risen to about 46,000,000 pounds in December. This copper ore, carrying a low content of gold and silver, accounted for nearly all the district gain in gold and silver output. The Bingham district showed decreases in 1941 in both tonnage and grade of zinc-lead ore mined, the Park City region showed an increase in tonnage but a decrease in grade, and Tooele County showed a decrease in tonnage; but the Tintic district trebled its tonnage of zinc-lead ore. In 1941 the production of siliceous ores declined from that in 1940; the largest decreases were in the output of gold ore in Tooele County and of gold, gold-silver, and silver ores in the Tintic district. In 1941 these two regions supplied about 90 percent of the siliceous ore output of the State.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Utah in 1941, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	24	328,576	42,171	130,260	426,316	288,914	
Dry and siliceous gold-silver ore	33	199,866	12,091	946,277	899,469	5,983,069	
Dry and siliceous silver ore	34	94,208	3,895	1,256,541	1,077,433	2,984,530	
	91	622,650	58,157	2,333,078	2,403,218	9,256,513	
Copper ore	19	30,444,402	243,953	2,285,377	[1] 526,670,055	66,065	
Lead ore	75	77,979	9,602	988,000	520,475	19,102,639	
Lead-copper ore	4	5,276	41	76,459	264,196	1,992,105	
Zinc ore	4	2,302	10	8,046	39,932	26,575	828,600
Zinc-lead ore	29	[2] 798,864	44,102	5,692,372	3,740,535	108,497,841	83,048,491
Zinc-lead-copper ore	2	1,344	7	12,063	37,589	260,262	220,909
Total, lode mines	[3] 167	31,952,817	355,872	11,395,395	[1] 533,676,000	139,202,000	84,098,000
Total, placers	12		629	90			
	179	31,952,817	356,501	11,395,485	[1] 533,676,000	139,202,000	84,098,000
Total, 1940	212	27,939,346	355,494	12,172,299	[4] 463,728,000	151,376,000	87,576,000

[1] Includes 13,418,668 pounds recovered from mine-water precipitates.
[2] Includes 29,658 tons of zinc-lead slag.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 14,223,006 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

In 1941, 31,952,817 tons of Utah ores were treated—a quantity that exceeded the 1940 record output by 14 percent—as follows: 31,205,481 tons at concentrating mills compared with 27,215,217 tons in 1940; 252,080 tons at cyanidation mills compared with 297,567 tons in 1940; 515 tons at amalgamation mills compared with 520 tons in 1940; 465,083 tons shipped crude to smelters compared with 426,042 tons in 1940; and 29,658 tons of zinc-lead slag fumed compared with none in 1940. A considerable tonnage of siliceous ore, included in the quantity shipped crude to smelters, came from old dumps and tailings piles and was used primarily as a flux in smelting. The siliceous fluxing ores usually were sold upon a per-ton basis, and the shipper received further payments if the metal content exceeded certain base minimums established by the smelters.

All the ore cyanided was handled at two cyanide plants at Mercur, each treating considerable custom ore; the total (252,080 tons) yielded 17,804 ounces of gold and 65 ounces of silver. These two plants reported a consumption of 140,500 pounds of sodium cyanide (91-percent grade), 1,730,460 pounds of lime, and 26,991 pounds of zinc dust. Eleven concentrating plants were active in Utah during 1941—three plants (Arthur, Magna, and Ohio Copper) treated 30,432,336 tons of copper ore and old tailings; four mills (Bauer, Midvale, Silver King, and Tooele), having a combined rated daily capacity of 4,800 tons, treated 754,345 tons of ore mostly zinc-lead and zinc-lead-copper; three gravity-concentration mills (one in Beaver County, one in Tooele County, and one in Utah County) treated 800 tons of lead ore;

and one flotation mill in Summit County treated 18,000 tons of zinc-lead tailings. One slag-fuming plant at Tooele treated 29,658 tons of slag.

The following tables give details of treatment for all the ore produced in Utah in 1941.

Mine production of metals in Utah in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	515	35	122			
Ore cyanided	252,080	17,804	65			
Concentrates smelted	1,073,438	286,575	7,973,147	516,364,567	108,895,218	83,920,987
Slag fumed	29,658					
Ore smelted	465,083	51,458	3,422,061	3,892,765	30,306,782	177,013
Mine-water precipitates smelted[1]	8,320			13,418,668		
Placer		629	90			
		356,501	11,395,485	533,676,000	139,202,000	84,098,000
Total, 1940		355,494	12,172,299	463,728,000	151,376,000	87,576,000

[1] All from Salt Lake County.

Mine production of metals from concentrating mills in Utah in 1941, by counties, in terms of recovered metals

County	Ore milled	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	2,009	836	10	13,768	39,932	109,920	705,000
Juab	12,243	3,268	141	55,770	300	942,500	1,554,000
Salt Lake	30,830,073	969,475	266,818	4,641,544	514,899,969	65,260,492	40,994,587
Summit	206,604	61,206	3,251	1,607,154	657,177	28,231,464	26,355,000
Tooele	41,480	17,943	1,567	275,117	113,985	7,334,880	4,808,400
Utah	1,773	983	32	13,174	2,922	226,637	492,000
Wasatch	111,299	19,727	14,752	1,364,505	648,782	6,432,325	5,998,000
	31,205,481	1,073,438	286,571	7,971,032	516,363,067	108,538,218	80,906,987
Total, 1940	27,215,217	1,011,236	263,721	8,212,922	444,939,519	123,620,563	87,473,400

Gross metal content of concentrates produced from ores mined in Utah in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper	789, 335	242, 456	2, 254, 125	528, 398, 263		
Lead	82, 928	14, 055	3, 970, 270	2, 369, 549	94, 256, 349	6, 953, 865
Lead-copper	4, 693	5, 501	520, 964	415, 686	5, 193, 450	586, 649
Zinc	42, 373	2, 613	406, 651	426, 618	2, 164, 035	48, 020, 622
Zinc-lead	41, 662	3, 079	268, 721	866, 348	6, 218, 267	41, 877, 122
Dry iron (from zinc-lead ore)	112, 447	18, 867	550, 301	827, 634	6, 077, 799	5, 187, 862
	1, 073, 438	286, 571	7, 971, 032	533, 304, 098	113, 909, 900	102, 626, 120
Total, 1940	1, 011, 416	263, 903	8, 212, 922	460, 038, 946	130, 525, 928	117, 278, 022

Mine production of metals from Utah concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	836	10	13, 768	39, 932	109, 920	705, 000
Juab	3, 268	141	55, 770	300	942, 500	1, 554, 000
Salt Lake	969, 475	266, 818	4, 641, 544	514, 899, 969	65, 260, 492	40, 994, 587
Summit	61, 206	3, 251	1, 607, 154	657, 177	28, 231, 464	26, 355, 000
Tooele	17, 943	1, 567	275, 117	113, 985	7, 334, 880	4, 808, 400
Utah	983	32	13, 174	2, 922	226, 637	492, 000
Wasatch	19, 727	14, 752	1, 364, 505	648, 782	6, 432, 325	5, 998, 000
	1, 073, 438	286, 571	7, 971, 032	516, 363, 067	108, 538, 218	80, 906, 987
Total, 1940	1, 011, 416	263, 903	8, 212, 922	444, 939, 519	123, 620, 563	87, 473, 400

BY CLASSES OF CONCENTRATES SMELTED

Copper	789, 335	242, 456	2, 254, 125	512, 546, 305		
Lead	82, 928	14, 055	3, 970, 270	1, 693, 635	90, 459, 481	
Lead-copper	4, 693	5, 501	520, 964	287, 550	4, 985, 069	
Zinc	42, 373	2, 613	406, 651	404, 891	1, 969, 181	43, 217, 493
Zinc-lead	41, 662	3, 079	268, 721	823, 031	5, 658, 624	37, 689, 494
Dry iron (from zinc-lead ore)	112, 447	18, 867	550, 301	607, 655	5, 465, 863	
	1, 073, 438	286, 571	7, 971, 032	516, 363, 067	108, 538, 218	80, 906, 987

Gross metal content of Utah crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	75,981	24,332	130,073	439,560	414,152	
Dry and siliceous gold-silver	199,866	12,091	946,277	927,129	9,876,699	
Dry and siliceous silver	94,208	3,895	1,256,541	1,113,618	4,933,553	
Copper	12,066	1,497	31,252	727,405	95,787	
Lead	77,179	9,602	981,459	641,513	20,654,998	
Lead-copper	5,276	41	76,459	404,190	2,075,144	
Zinc	393				7,217	163,864
Zinc-lead	114				37,782	66,766
	465,083	51,458	3,422,061	4,253,415	38,095,332	230,630
Total, 1940	426,042	73,754	3,958,814	4,915,443	33,454,947	114,256

Mine production of metals from Utah crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	2,378	259	17,687	23,668	214,080	
Box Elder	257	60	10,762	900	2,000	
Grand	5		14			
Iron	176	4	806	800	55,700	
Juab	163,927	10,301	816,001	671,700	6,219,500	
Millard	1,128	379	315	700	1,900	
Morgan	17		21		7,300	
Piute	2,121	929	8,543	900	23,000	
Salt Lake	37,753	8,550	238,602	1,158,363	4,055,508	53,413
Sevier	35	15	329		400	10,000
Summit	16,956	1,321	210,995	167,823	3,076,536	
Tooele	63,064	15,497	179,332	389,515	4,463,820	113,600
Uintah	2		3	100		
Utah	174,526	13,720	1,850,096	1,445,078	11,739,363	
Wasatch	2,736	423	88,545	33,218	447,675	
Washington	2		10			
	465,083	51,458	3,422,061	3,892,765	30,306,782	177,013
Total, 1940	426,042	73,754	3,958,814	4,565,475	27,755,437	102,600

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	75,981	24,332	130,073	426,316	288,914	
Dry and siliceous gold-silver	199,866	12,091	946,277	899,469	5,983,069	
Dry and siliceous silver	94,208	3,895	1,256,541	1,077,433	2,984,530	
Copper	12,066	1,497	31,252	705,082	66,065	
Lead	77,179	9,602	981,459	520,269	18,962,247	
Lead-copper	5,276	41	76,459	264,196	1,992,105	
Zinc	393				3,405	123,600
Zinc-lead	114				26,447	53,413
	465,083	51,458	3,422,061	3,892,765	30,306,782	177,013

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver County:													
Beaver Lake	1		19				83		83		6,000		$401
Bradshaw	1		12	3		3	38		38				132
Rocky	2		331	7		7	734		734	20,000			3,127
San Francisco	6		2,060	240		240	21,953		21,953	1,600	287,600	8,000	41,193
Star and North Star	6		1,965	19		19	8,647		8,647	42,000	30,400	697,000	65,778
Box Elder County:													
Ashbrook	2		257	60		60	10,762		10,762	900	2,000		9,973
Garfield County: Imperial		2			4	4							140
Grand County:													
Colorado River		4			252	252		59	59				8,862
Miners Basin	1		5				14		14				10
Iron County:													
Calumet	1		124				197		197	800	55,700		3,409
Stateline	2		552	37		37	727		727				1,812
Juab County:													
Detroit [1]	1		840	186		186	516		516	20,000	300		9,254
Fish Springs	2		27				997		997		8,000		1,165
Mount Nebo	2		3				7		7		900		56
Tintic [2]	21		175,267	10,250		10,250	869,940		869,940	651,800	7,144,700	1,554,000	1,578,084
West Tintic	1		33	6		6	311		311	200	8,100		917
Millard County:													
Detroit [1]	3		1,128	379		379	315		315	700	1,900		13,680
House Mountains		1			21	21							735
Morgan County: Argenta	2		17				21		21		7,300		431
Piute County:													
Gold Mountain	1		1,623	667		667	3,458		3,458				25,804
Mount Baldy	1		451	257		257	4,739		4,739	800	20,000		13,599
Ohio	1		47	5		5	346		346	100	3,000		604
Salt Lake County:													
Big Cottonwood	5		888	68		68	19,319		19,319	54,000	142,000	57,000	34,859
Little Cottonwood	4		575	129		129	6,511		6,511	10,000	120,000		17,165
"Smelter"	3		200	52		52	2,444		2,444	4,000	30,000		5,740
West Mountain	15		30,866,163	275,119		275,119	4,851,872		4,851,872	529,409,000	69,024,000	40,991,000	82,558,340
San Juan County:													
Bluff		1			1	1							35
Colorado River		1			17	17							595

Sevier County:													
Henry	2		7	15		15	329		329				759
Redmond	1		28								400	10,000	773
Summit County: Uintah	8		223,560	4,572		4,572	1,818,149		1,818,149	825,000	31,308,000	26,355,000	5,311,457
Tooele County:													
Camp Floyd	8		292,163	29,980		29,980	436		436				1,049,610
Clifton	1		16	1		1	308		308	3,100	300		637
Dugway	1		317	3		3	675		675	800	73,000	24,800	6,700
Free Coinage	1		4				21		21		2,300		146
Lakeside	3		1,406	2		2	1,163		1,163	2,200	270,700		16,587
North Tintic	1		396				52		52		13,400	113,800	9,321
Ophir	12		18,315	201		201	158,009		158,009	408,500	2,874,000	345,600	357,338
Rush Valley	11		42,625	} 1,814		1,814	283,088		283,088	87,400	8,336,700	7,452,000	1,309,202
"Smelter"	1		29,658										
Silver Island	1		1				66		66		300		64
Willow Springs	4		1,381	2,871		2,871	12,811		12,811	3,000	585,000		143,294
Uintah County:													
Carbonate	1		2				3		3	100			14
Green River		3			334	334		31	31				11,712
Utah County:													
American Fork	8		2,128	51		51	21,119		21,119	14,000	246,300	452,000	66,394
Payson Canyon	1		49	1		1	204		204	1,500			357
Santaquin	1		46				97		97		15,600		958
Tintic [2]	11		174,076	13,700		13,700	1,841,850		1,841,850	1,432,500	11,704,100	40,000	2,628,429
Wasatch County:													
Blue Ledge	2		55,249	3,620		3,620	849,683		849,683	217,000	2,555,000	2,335,600	1,077,330
Snake Creek	2		58,786	11,555		11,555	603,367		603,367	465,000	4,325,000	3,662,400	1,409,561
Washington County:													
Bull Valley	2		17	2		2	14		14				80
Total Utah	167	12	31,952,817	355,872	629	356,501	11,395,395	90	11,395,485	533,676,000	139,202,000	84,098,000	97,796,623

[1] Detroit district lies in both Juab and Millard Counties.

[2] Tintic district lies in both Juab and Utah Counties.

BEAVER COUNTY

Beaver Lake district.—A small shipment of silver-lead ore from the property of the Beaver Gold & Copper Co. comprised the output of the Beaver Lake district in 1941.

Bradshaw district.—Production in the Bradshaw district during 1941 came from a small lot of gold ore shipped crude to a smelter.

Rocky district.—The Prosper Mining Co. operated the Old Hickory group in 1941 and shipped 2 cars of gold-silver-copper ore direct to a smelter; the property was operated primarily for the tungsten content of the ore. Crude ore was shipped direct to a smelter from the Montreal property also.

San Francisco district.—The Horn Silver Mines Co. shipped lead ore crude to a smelter in 1941 and was the largest producer in the San Francisco district. Most of the remainder of the district metal output was from zinc ore from the King David property and lead ore from the Quad Metals Corporation property.

Star and North Star district.—The bulk of the district output came from zinc ore shipped from the Moscow Silver property to Tooele for treatment. Most of the remainder came from small shipments of lead, silver, and gold ore shipped crude to smelters from several properties.

BOX ELDER COUNTY

Ashbrook district.—Silver ore, all from the Vipont property, comprised virtually the entire output of the Ashbrook district in 1941.

IRON COUNTY

Calumet district.—Lead ore shipped crude to a smelter from the property of the New Arrowhead Mining Co. comprised the output from the Calumet district in 1941.

Stateline district.—Gold ore from the property of Aetna Gold Mines, Inc., treated by amalgamation, yielded most of the output from the Stateline district.

JUAB COUNTY

Detroit district.—The Ibex property shipped gold ore crude to a smelter in 1941 and accounted for the entire output from the Juab County section of the Detroit district.

Fish Springs district.—Lead ore shipped direct to a smelter from the Black Dragon and Utah Mine group comprised the output of the Fish Springs district in 1941.

Tintic district.—The Tintic district, which lies in both Juab and Utah Counties, is reviewed here. The table that follows gives the metal production in each section of the district for 1941, a comparison with the total output in 1940, and the grand total from 1869 to 1941.

In 1941 the Chief Consolidated Mining Co. operated the Chief No. 1, Gemini, Eureka Hill, and Plutus mines in Juab County. Development operations on the Apex Standard area were continued during the year but were suspended in January 1942 awaiting the receipt of premium metal quotas. Although most of the company output was contained in ore from the Chief No. 1 property, large tonnages of siliceous tailings were shipped to Garfield from the Eureka Hill and Chief No. 1 dumps. According to the company printed annual report, production of gold, silver, and copper decreased from that in

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1940–41, and total, 1869–1941, in terms of recovered metals

	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
1941		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	21	175,267	10,250	869,940	651,800	7,144,700	1,554,000	$1,578,084
Utah County	11	174,076	13,700	1,841,850	1,432,500	11,704,100	40,000	2,628,429
	32	349,343	23,950	2,711,790	2,084,300	18,848,800	1,594,000	4,206,513
Total, 1940	34	283,046	38,775	2,958,312	2,590,717	13,072,720	449,714	4,431,977
Total, 1869–1941	....	(1)	2,498,332	253,425,174	236,922,464	1,798,012,879	40,745,738	376,593,595

1 Figures not available.

1940, but the output of lead and zinc increased. Production in 1941, says the report, comprised 34,397 tons of siliceous ore, 288 tons of silver-lead ore, and 12,619 tons of zinc-lead ore from the Chief No. 1 mine; 6,280 tons of siliceous ore and 382 tons of silver-lead ore from the Gemini mine; 2,086 tons of siliceous ore from the Eureka Hill mine; and 851 tons of siliceous ore and 28 tons of silver-lead ore from the Plutus mine—an aggregate of 56,931 tons of ore of all classes, which contained 2,115 ounces of gold, 361,832 ounces of silver, 74,436 pounds of copper, 1,448,574 pounds of lead, and 2,064,340 pounds of zinc. Total development work was 3,989 feet and included three major projects, none of which reached its objective. The Centennial-Beck, Victoria, and Eagle & Blue Bell properties, all owned or controlled by the United States Smelting, Refining & Mining Co., were operated on company account during the year; lessees worked the American Star mine until April 1941, when all operations stopped. The total production from these properties comprised 4,790 tons of lead ore and 13,309 tons of siliceous ore, all of which was shipped crude to smelters. The Dragon, Martha Washington, and the Empire group (formerly Empire-Star), all owned or controlled by the International Smelting & Refining Co., were operated in 1941 by lessees; the production was siliceous gold-silver ore shipped direct to a smelter. The Godiva mine, operated by a lessee, yielded 29,936 tons of ore of all classes, principally siliceous ore, which was shipped direct to a smelter. The Mammoth Mining Co. operated its property all of 1941 and shipped 20,533 tons of siliceous ore and 1,415 tons of lead ore direct to a smelter. The remainder of the output of the Juab County section of the Tintic district was predominantly siliceous ore shipped direct to smelters and came principally from the Windridge, Alaska, Showers, and Park Utah mines and the dump of the Grand Central mine.

The Tintic Standard Mining Co. and its subsidiary companies, largest producers in the Utah County section of the Tintic district in 1941, produced lead ore and siliceous ore. The printed annual report of these companies gives the following operating details. Ore production at the Tintic Standard mines (including the Iron Blossom) increased 12,118 tons over 1940. Most of the ore was siliceous in character and was mined on company account. The Eureka Lilly Consolidated mines produced 6,500 tons of ore, largely siliceous, which was mined chiefly by lessees; the Colorado Consolidated and Sioux mines were operated by lessees and produced 3,511 and 404 tons, respectively, chiefly

siliceous ore. The tonnage of ore of all classes aggregated 126,878 (92,630 tons was siliceous ore), which had the following metal content: 6,194 ounces of gold, 1,656,180 ounces of silver, 1,236,937 pounds of copper, and 13,186,346 pounds of lead; the siliceous ore averaged 2.5 percent lead. In addition, 31,673 tons of siliceous material from the Harold dump were shipped crude to Garfield; it contained over 1,000,000 pounds of lead. Development during 1941 totaled 5,669 feet of drifts and raises and 66 feet of shafts. During the year the lead ore shipped was higher in lead content, but substantially lower in silver; in the siliceous ores, the content of gold and silver was lower. Active mines in the Utah County section of the Tintic district, owned or controlled by the International Smelting & Refining Co. and its subsidiaries, were the Eureka Bullion, May Day (Mountain View), North Lily, Tintic Bullion, and Yankee.

West Tintic district.—Crude lead ore from the Scotia mine, operated by a lessee, comprised the output from the West Tintic district in 1941.

MILLARD COUNTY

Detroit district.—Siliceous gold ore shipped direct to a smelter comprised the output from the Millard County section of the Detroit district in 1941. The Charm mine was the principal producer.

MORGAN COUNTY

Argenta district.—Crude lead ore shipped direct to a smelter, principally from the Dan Heiners claim, comprised the output from the Argenta district in 1941.

PIUTE COUNTY

Gold Mountain district.—Lessees operating the property of Annie Laurie Consolidated Gold Mines, only producer in the Gold Mountain district in 1941, shipped 1,623 tons of gold ore to a smelter.

Mount Baldy district.—The property of the Deer Trail Mining Co., only producer in the Mount Baldy district in 1941, was operated by a lessee from July to the end of the year; 451 tons of siliceous ore were shipped direct to a smelter.

Ohio district.—Siliceous ore shipped crude to a smelter from the Bully Boy property of the American Mineral Products Co. was the only production from the Ohio district in 1941.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—Lessees operated the Cardiff property in the Big Cottonwood district during 1941 and shipped 644 tons of ore—152 tons of lead ore, 368 tons of copper ore, and 124 tons of zinc-lead ore. The output from the Mountain Mines Co. property, second-largest producer in the district in 1941, totaled 200 tons of ore shipped crude to a smelter; the company completed the lower development tunnel and made contact with vein at 2,000-foot depth. Other producers in the district were the Utah-Kentucky Mines Co. and the Tar Baby Mining Co.; both shipped crude ore to a smelter.

Silver-lead ore, lead-copper ore, and copper ore shipped crude to a smelter comprised the output of the Little Cottonwood district in 1941.

The principal producers were the Wasatch Mines Co. and Columbus Rexall Consolidated Mines Co.

"Smelter" district.—The output from the "Smelter" district in 1941 came principally from the Mingo and Germania dumps and from clean-ups at the Utah Ore Sampling Co. yards and tracks.

West Mountain (Bingham) district.—The Bingham district, by far the outstanding mining region of Utah, produced most of the State output of copper and gold, nearly half of the zinc and lead, and more than a third of the silver in 1941; the value of these five metals was $82,558,340, or 84 percent of the value of the entire State output during the year. The following table gives the production from mines at Bingham in 1940 and 1941 and the total for the district from 1865 to 1941.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1940–41, and total, 1865–1941, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1940	14	26,753,382	256,558	4,760,252	457,010,531	75,713,100	43,623,397	$70,540,717
1941	15	30,866,163	275,119	4,851,872	529,409,000	69,024,000	40,991,000	82,558,340
Total, 1865–1941		(1)	4,470,927	121,990,525	[2] 3,425,919	[2] 1,420,362	[2] 392,245	1,367,736,039

[1] Figures not available.
[2] Short tons.

Utah Copper Co. operations accounted for most of the gain over 1940 in value of gold and silver produced and virtually all the gain in value of copper produced in the Bingham district in 1941. These gains in output were attained only through an all-out effort, started before 1941 and stimulated further by the present urgent need for copper. During 1941 the company milled an average of about 83,000 tons a day at its two flotation-concentration mills. The average copper content of the ore treated was slightly higher than in 1940, due chiefly to the fact that a larger portion of the ore came from the lower levels of the Bingham pit. Ore and waste were mined at a rate exceeding 188,000 tons a day. The waste rock was piled in adjacent gulches and leached there. In addition to the vast quantity of copper recovered from copper concentrates, the company recovered about 13,000,000 pounds of copper from the copper-precipitating plant at Lead Mine. The gold, silver, and molybdenite production from these copper ores far exceeded that of any other properties in the State, and the company ranked high among the leading gold and silver producers and second in production of molybdenite in the United States. In May 1942 the company exceeded its 1941 production schedule and was producing copper at the rate of about 600,000,000 pounds a year. The Kennecott Copper Corporation revealed the following operating details in its printed annual report. The mine operated 364 days during 1941, and the tonnage of ore hauled to the concentrators for treatment was 16 percent above that in 1940. The railroad congestion resulting from this larger tonnage

necessitated construction of a supplemental train-assembly yard about 1 mile from the main yard at Bingham.

The Boston Consolidated property, owned by the Utah Copper Co., was operated under lease by the American Smelting & Refining Co. Crude copper ore was shipped direct to a smelter.

The zinc and lead output of the Bingham district was produced largely by the United States & Lark mine, owned and operated by the United States Smelting, Refining & Mining Co. The tonnage of gold-silver ore and lead ore shipped for smelting increased slightly over the output in 1940, when 13,311 tons were shipped. The tonnage of zinc-lead ore shipped for milling at Midvale in 1941 was slightly less than in 1940 and lower in zinc and lead content but higher in gold and silver. In 1941 this property was second in silver and third in gold output in the State. During the first quarter of 1942, the property showed a marked increase in zinc-lead output over the monthly average for 1941. Development work consisted of driving 560 feet of shaft and 19,731 feet of raises. The Niagara mine shipped over 12,000 tons of ore of all classes to Midvale for treatment, and most of it was zinc-lead mill ore. The Montana-Bingham Consolidated Mining Co. shipped over 7,100 tons of ore of all classes. The Utah Metal property, leased by the United States Smelting, Refining & Mining Co., was the only other property active in the Bingham district in 1941 among those owned or controlled by the United States Smelting, Refining & Mining Co.; small shipments of zinc-lead ore were made incident to development of the property.

The National Tunnel & Mines Co. operated the Apex Delaware group from January through July 1941 on company and lessee account. The output was chiefly zinc-lead ore shipped to the Tooele sulfide concentrator and amounted to approximately one-half that produced in 1940. The Elton tunnel, driven by the National Tunnel & Mines Co., was completed in July 1941 as far as the main objective—reaching the Rood shaft in the Utah Apex mine. The rest of the year was spent mainly in rehabilitation of old workings and work preparatory to the extraction of ore. Limited production from the property was under way in April 1942; it is anticipated that by June 1942 normal production will have been established.

The Ohio Copper Co. treated 341,936 tons of old tailings, containing 2,097,531 pounds of copper in concentrates; in addition, 422 tons of copper precipitates were produced. The 1,000-ton flotation mill treated a daily average of 958 tons of tailings.

A total of over 31,000 tons of ore of all classes was shipped fom the Butterfield properties to the Combined Metals Reduction Co. concentrating plant at Bauer and to the International Smelting & Refining Co. at Tooele, or considerably less than the output in 1940.

Among other producers in the Bingham district in 1941 were the New England, Chicago, Kremlin, and Colonel Sellers properties, which shipped crude ore direct to smelters.

SEVIER COUNTY

Henry district.—Siliceous ore shipped crude to a smelter from the B. W. & H. property and from the Yellow Cougar No. 1–4 comprised the output from the Henry district in 1941.

Redmond district.—Zinc ore shipped crude to the Tooele slag-fuming plant was the only output from the Redmond district in 1941.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The Park City region includes the Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County. In 1941 the region produced gold, silver, copper, lead, and zinc valued at $7,798,348. The following table gives the output from the Park City region in 1940 and 1941 and the total since 1870.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1940–41, and total 1870–1941, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1940	12	311,906	17,300	3,333,122	1,296,000	39,497,400	35,195,000	$7,314,323
1941	12	337,595	19,747	3,271,199	1,507,000	38,188,000	32,353,000	7,798,348
Total, 1870–1941		(1)	473,385	226,668,134	63,327,513	2,287,946,834	585,052,911	336,879,568

1 Figures not available.

The Silver King mine and 800-ton flotation plant operated throughout 1941 and showed gains from 1940 in output of gold, silver, copper, and zinc but a decline in lead. The 800-ton flotation concentrator treated a daily average of 457 tons of zinc-lead ore, operating 5 days a week and three shifts a day. The gross metal content of the mill feed was virtually the same as in 1940, but no crude lead ore was shipped, as in the preceding year.

A total of 26,702 feet of development work was completed during 1941. According to the company printed annual report, the 116,443 tons of zinc-lead ore mined and milled produced lead, zinc, and iron concentrates that contained 1,855 ounces of gold, 1,173,437 ounces of silver, 598,953 pounds of copper, 15,732,531 pounds of lead, and 14,552,673 pounds of zinc. In addition, 1,092 tons of 62-percent zinc concentrates held in storage were sold.

The Park Utah Consolidated Mines Co. operated the Park Utah Consolidated Mines group in Summit County and the Keetley unit in Wasatch County continuously in 1941. All the ore was sent to the International smelter and mill for treatment. According to the company printed annual report, the 73,073 tons of ore produced contained 1,709 ounces of gold, 470,327 ounces of silver, 85,267 pounds of copper, 16,908,115 pounds of lead, and 15,716,159 pounds of zinc. Extensive development work was carried on at the property of the Park City Utah Mines Co. (affiliate of the Park Utah Consolidated Mines Co.) in Wasatch County. From the Park City Utah group the company produced 9,351 tons of ore of all classes, which was shipped to the International mill and smelter for treatment. In addition, the Park Utah Consolidated Mines Co. mined and shipped over 5,000 tons of zinc-lead ore, for the Daly Mining Co. from its Daly group, to the International smelter.

As part of its 1942 program, in view of the urgent need for base metals, the Park Utah Consolidated Mines Co. has reopened the orig-

inal main shaft at the Keetley unit, and extraction of the pillar of ore left around this shaft below the drainage-tunnel level has been begun. The additional tonnage from this section will bring an excess production over 1941 for the immediate future; but its tonnage is limited, and any excess production later in the year must necessarily come as a result of the favorable outcome of exploratory drives now in progress and those to be started in the near future. To increase the scope of the exploratory drives, the Anaconda Copper Mining Co. purchased a large share in the control of the company in April 1942.

The Park City Consolidated Mines Co. produced 45,998 tons of zinc-lead ore in 1941 from its Roosevelt and East Crescent groups and shipped it to the Midvale concentrator for treatment. The company produced about 70 percent as much ore as in 1940, but that mined and shipped in 1941 was of higher grade.

The New Park Mining Co. mined and shipped to the Midvale concentrator 58,600 tons of zinc-lead-copper ore, a gain of about 16,000 tons over 1940. The company was by far the leading gold producer in the region. In 1941 ore sent to Midvale for treatment contained 13,638 ounces of gold, 666,783 ounces of silver, 693,385 pounds of copper, 4,871,141 pounds of lead, and 4,978,013 pounds of zinc. A 2-mile railroad spur was constructed from Keetley to Cranmer, portal of the Mayflower tunnel; however, in 1941 all ore was hauled to Keetley for shipment. Development work was carried on continuously. Late in the year a shaft was started to permit exploring the levels below the Mayflower tunnel. Early in 1942 the mining crews were placed on a 7-day week and three-shift day. At the end of the first quarter of 1942, the company was producing at a rate that would exceed its 1941 output of all metals by a substantial margin.

The Marsac Mining Co., lessee on the Park Flag mine, operated the property for the first 6 months of 1941; at that time, the lease was transferred to D. C. Despain, and operations were continued for the rest of the year. About 3,400 tons of siliceous ore plus 800 tons of zinc-lead ore were shipped for treatment.

The remainder of the production from the Park City region came from shipments of zinc-lead ore and crude silver ore sent to smelters and mills, principally from the New Quincy property and from old tailings on Silver Creek and near Park City.

TOOELE COUNTY

Mines in Tooele County produced gold, silver, copper, lead, and zinc valued at $2,892,899 in 1941 compared with $3,747,433 in 1940. This decline in value of output was due chiefly to decreased output from mines in the Camp Floyd, Ophir, and Rush Valley districts, which more than offset the gain by the output of the Tooele slag-fuming plant.

Camp Floyd district.—Gold output in the Camp Floyd district decreased in 1941 compared with 1940. Snyder Mines, Inc., was again the largest producer in the district and treated over 168,000 tons of gold ore from company and custom shipments. The Geyser Marion Gold Mining Co. operated the Geyser Marion mill until the middle of June, when the mill was taken over by Snyder Mines, Inc. During the latter half of 1941, virtually all the gold output of the district was controlled by Snyder Mines, Inc. In addition to produc-

tion from the cyanide mills, about 40,000 tons of siliceous gold ore were shipped direct to Garfield for fluxing purposes. Active mines in the district included the Consolidated Mercur, New Mercur, La Cigale, Omaha, Sacramento, Geyser Marion, and Boston Sunshine.

Clifton (Gold Hill) district.—The Western Utah Copper property was the only producer in the Clifton district in 1941.

Dugway district.—Crude lead ore and zinc-lead ore were shipped direct to the International smelter and Bauer mills, respectively, for treatment from the Four Metals property, only active mine in the Dugway district in 1941.

Free Coinage district.—A small shipment of lead ore, sent direct to a smelter from the Utah Bunker Hill mine, was the only production from the Free Coinage district in 1941.

Lakeside district.—Lead ore shipped crude to a smelter from the Georgia Lyn, Lead Prince, and Monarch mines comprised the output from the Lakeside district in 1941.

North Tintic district.—The Scranton property was operated by lessees in 1941, and shipments of zinc ore and lead ore were made direct to the smelters.

Ophir district.—There was a sharp drop from 1940 in the metal output from the Ophir district in 1941, due chiefly to the decline in output from the Hidden Treasure mine, largest producer in the district. The property was operated by the United States Smelting, Refining & Mining Co. The tonnage of lead-copper ore shipped crude to the Midvale smelter was 3,000 tons less than in 1940; the production of zinc-lead-copper ore amounted to about 400 tons. The Ophir Development Co. operated the Ophir Coalition and Ophir Hill properties in 1941 and shipped to smelters 3,825 tons of ore of all classes. In addition, 1,675 tons of zinc-lead and zinc-lead-copper ores were shipped to the International sulfide concentrator. High-grade lead ore was shipped crude to a smelter by the Mecca Mining Co. (formerly the Cliff Lease) from the Wandering Jew. Among other mines active in the Ophir district were the Northern Light, Queen of the Hills, and the Mono group.

Rush Valley district.—The output from the Rush Valley district in 1941 declined from that in 1940. The West Calumet (Calumet) property, owned and operated by the Combined Metals Reduction Co., was by far the largest producer in the district in 1941. Over 38,000 tons of zinc-lead ore from the Calumet were treated at the Bauer plant, and in addition over 1,000 tons of crude ore were shipped direct to a smelter. Lead ore was shipped crude to the International smelter from the Bluestone mine in 1941. Other producers in the district included the Honerine, Salvation-Hercules, and Argenta.

"Smelter" district.—The International Smelting & Refining Co. erected a slag-fuming plant at the smelter location near Tooele. The plant was completed in September 1941 and during the rest of the year treated over 29,000 tons of zinc-lead slag and a few hundred tons of crude zinc ore. Zinc recovery averaged nearly 1,000,000 pounds a month during 1941. During the first quarter of 1942, the production had exceeded 1,000,000 pounds a month. The zinc fume produced averaged over 65 percent zinc and 2 percent lead and was shipped to the Anaconda Copper Mining Co. and to Bartlesville (Okla.) for treatment. The lead fume averaged about 45 percent lead and was treated at the Tooele lead smelter.

Willow Springs district.—The bulk of the output of the Willow Springs district came from rich gold ore and lead ore shipped crude to smelters from the Oro Del Rey and Depression mines.

UINTAH COUNTY

Most of the output from Uintah County was placer gold and silver recovered from the Big Bend, D. J. McConnell, and Utah State Lease No. 788 properties in the Green River district.

UTAH COUNTY

American Fork district.—The Dutchman mine was the largest producer in the American Fork district in 1941 and shipped 998 tons of high-grade zinc-lead ore to Midvale. Other mines active in 1941 included the Blue Rock, Bog Iron, Red Cloud, and Live Yankee.

Payson Canyon district.—A test lot of copper ore was shipped crude to a smelter from the Payson Canyon district.

Santaquin district.—One carload of lead ore was shipped crude to a smelter from the Elsie Jane mine in 1941.

Tintic district.—Mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

Gold ore amalgamated and a test shipment of silver ore sent direct to a smelter comprised the output from the Bull Valley district in 1941.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

Ores and gravels from mines in Washington yielded gold, silver, copper, lead, and zinc valued at $7,874,886 in 1941 compared with $7,018,812 in 1940. The output of each metal except copper increased. The gain in value of total output was due chiefly to greater production of lead and zinc, which was stimulated by the urgent need for these metals. Gold and silver production improved owing to a sharp rise in output from the Republic district, Ferry County, which more than balanced losses in the Methow district in Okanogan County and by the Howe Sound Co. in the Chelan Lake district, Chelan County. The bulk of the State copper production came from the Holden property of the Howe Sound Co. The decline from the 1940 output of copper can be ascribed to the lower grade of ore treated. The production of lead and zinc, which was derived chiefly from ores mined in Pend Oreille County, gained sharply over 1940 due principally to full-year operation of the properties of the Metaline Mining & Leasing Co. and the American Zinc, Lead & Smelting Co.; however, the Pend Oreille Mines & Metals Co. was the largest producer in the county. The productive effort of these three zinc and lead producers was greatly stimulated by defense requirements.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc. 1937–41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35 00	$0 7735	$0.121	$0 059	$0.065
1938	35 00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052
1940	35.00	[6].711+	.113	.050	.063
1941	35 00	[6].711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1937. Yearly average weighted Treasury buying price for newly mined silver; 1938–41: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1937–41, and total, 1860–1941, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1937	65	90	294,826	36,310	$1,270,850	126,304	$97,696
1938	77	80	901,689	74,175	2,596,125	380,938	246,263
1939	88	84	1,124,564	90,420	3,164,700	442,063	300,067
1940	83	88	1,166,798	82,136	2,874,760	365,175	259,680
1941	61	56	1,238 509	84,176	2,946,160	402,030	285,888
1860–1941			(1)	1,881,725	44,615,698	11,222,890	7,941,147

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1937	128,000	$15,488	5,660,000	$333,940	8,232,000	$535,080	$2,253,054
1938	12,034,000	1,179,332	8,568,000	394,128	22,804,000	1,094,592	5,510,440
1939	17,996,000	1,871,584	7,436,000	349,492	20,262,000	1,053,624	6,739,467
1940	19,224,000	2,172,312	5,110,000	255,500	23,120,000	1,456,560	7,018,812
1941	17,372,000	2,049,896	7,806,000	444,942	28,640,000	2,148,000	7,874,886
1860–1941	[2] 47,064	12,151,301	[2] 53,276	6,506,580	[2] 76,288	8,896,994	80,111,720

[1] 1860–1903: Figures not available; 1904–41: 7,164,273 tons produced. [2] Short tons.

Gold and silver produced at placer mines in Washington, 1937–41, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1937	371	$12,985	48	$37	$13,022
1938	1,575	55,125	218	141	55,266
1939	2,261	79,135	358	243	79,378
1940	2,747	96,145	720	512	96,657
1941	540	18,900	90	64	18,964

Gold.—The output of recoverable gold in Washington was 84,176 fine ounces in 1941, a gain of 2 percent over 1940 due almost entirely to gold recovered from gold concentrates shipped to a smelter; gold recovered by amalgamation increased slightly but that recovered from gold cyanide bullion, copper concentrates, and crude ore shipped to smelters declined from 1940. Gold recovered from gold bullion from ore treated at cyanidation plants (with or without concentration) in Ferry County declined 6,131 ounces, but that in Stevens County gained 559 ounces; gold recovered from gold concentrates made in the concentration sections of the cyanide mills in Ferry County increased 18,299 ounces. Gold from ores sent crude to smelters was virtually the same as in 1940 in Ferry County but declined 1,856 ounces in Okanogan County and 198 ounces in Chelan County. Gold ores treated in amalgamation plants, principally from Ferry, Okanogan, and Whatcom Counties, yielded 777 ounces of gold. Copper concentrates produced by the Howe Sound Co. yielded about 55 percent of the State total and gold concentrates

produced from the Knob Hill and Mountain Lion groups 23 percent. Other important producers of gold were the Aurum and Valley mines in Ferry County and the First Thought mine in Stevens County. The total output of gold ore in 1941 was 178,121 tons compared with 202,502 tons in 1940; it was treated as follows: 135,290 tons cyanided, 694 tons amalgamated, 3,747 tons concentrated, and 38,390 tons sent crude to smelters. Placers yielded 540 fine ounces of gold in 1941.

Silver.—Recoverable silver produced in Washington in 1941 totaled 402,030 fine ounces, a gain of 10 percent over 1940; most of it came from copper ores of Chelan County and gold ores of Ferry County and the remainder chiefly from copper ores of Stevens and Snohomish Counties. Of the State total, copper ores yielded 50 percent, gold ore 43, silver ore 3, and the combined production of zinc-lead, gold-silver, and lead ores and placer gravels 4 percent. The Holden mine in Chelan County was the largest producer, followed by the Knob Hill and Mountain Lion properties in Ferry County, operated by Knob Hill Mines, Inc.; these two companies produced 75 percent of the State total. Other important silver-producing mines were the Aurum and Valley in Ferry County and the Amazon & Copper King in Stevens County. Placer mines yielded 90 fine ounces of silver.

Copper.—Recoverable copper produced in Washington amounted to 17,372,000 pounds in 1941 compared with 19,224,000 pounds in 1940. Copper concentrates shipped by the Howe Sound Co. from its Holden property to Tacoma yielded about 96 percent of the State total copper. The gold value in the copper concentrates was equivalent to 82 percent of the copper value. Other important copper producers were the Sunset mine in Snohomish County and the Amazon & Copper King and Lucky Boy mines in Stevens County.

Lead and zinc.—The production of recoverable lead and zinc in Washington in 1941 increased 53 and 24 percent, respectively, over that in 1940. Three properties in Pend Oreille County produced 98 percent of the State total lead and 99 percent of the zinc. Zinc-lead ore treated in two flotation mills in Pend Oreille County in 1941 exceeded that treated in 1940 by 87,808 tons and was virtually of the same grade. The 700-ton flotation mill of the Pend Oreille Mines & Metals Co. was operated the entire work year 7 days a week and three shifts a day. Ore treated daily averaged 661 tons. The 450-ton Grandview mill of the Metaline Mining & Leasing Co. treated company ore and ore from the property of the American Zinc, Lead & Smelting Co.; during 1941 the daily capacity of the mill was increased from 450 to 500 tons, and it was operated practically at capacity all of 1941 three shifts a day and 7 days a week. The Sierra Zinc Co., operating the Blue Ridge property in Stevens County, erected a 50-ton mill (50-ton flotation capacity and 100-ton crushing capacity) and began operations in October 1941. The average grade of ore treated was about 1 percent lead and 8 percent zinc. Other producers of lead included the Electric Point and Gladstone Mountain properties in Stevens County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1941, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Asotin		13	129	$4,515	21	$15
Benton		5	27	945		
Chelan	5	3	46,048	1,611,680	175,891	125,078
Douglas		2	2	70		
Ferry	11	2	34,559	1,209,565	173,392	123,301
Grant		1	38	1,330	7	5
King	3		111	3,885	1,139	810
Kittitas		7	19	665	3	2
Okanogan	12	7	1,036	36,260	1,741	1,238
Pend Oreille	3	2	3	105	10,807	7,685
Pierce	1		3	105	14	10
Snohomish	4	2	125	4,375	16,591	11,798
Stevens	16	9	1,688	59,080	22,206	15,791
Whatcom	5	2	378	13,230	180	128
Whitman		1	9	315		
Yakima	1		1	35	38	27
	61	56	84,176	2,946,160	402,030	285,888
Total, 1940	83	88	82,136	2,874,760	365,175	259,680

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Asotin							$4,530
Benton							945
Chelan	16,731,000	$1,974,258					3,711,016
Douglas							70
Ferry	200	24					1,332,890
Grant							1,335
King	1,100	130	2,300	$131			4,956
Kittitas							667
Okanogan	55,000	6,490	1,600	91			44,079
Pend Oreille			7,637,900	435,360	28,402,000	$2,130,150	2,573,300
Pierce			100	6			121
Snohomish	364,500	43,011	700	40			59,224
Stevens	218,300	25,759	163,000	9,291	238,000	17,850	127,771
Whatcom	800	94	400	23			13,475
Whitman							315
Yakima	1,100	130					192
	17,372,000	2,049,896	7,806,000	444,942	28,640,000	2,148,000	7,874,886
Total, 1940	19,224,000	2,172,312	5,110,000	255,500	23,120,000	1,456,560	7,018,812

Gold and silver produced at lode mines in Washington in 1941, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Chelan	687,492	46,045	175,891
Ferry	160,756	34,550	173,392
King	817	111	1,139
Okanogan	3,806	1,027	1,741
Pend Oreille	361,041		10,807
Pierce	3	3	14
Snohomish	6,401	122	16,591
Stevens	17,397	1,409	22,147
Whatcom	781	368	180
Yakima	15	1	38
	1,238,509	83,636	401,940
Total, 1940	1,166,798	79,389	364,455

Gold and silver produced at placer mines in Washington in 1941, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dragline and dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Asotin	64	10	65	11	129	21
Benton	12		15		27	
Chelan	3				3	
Douglas	2				2	
Ferry	9				9	
Grant			38	7	38	7
Kittitas	19	3			19	3
Okanogan	9				9	
Pend Oreille	3				3	
Snohomish	3				3	
Stevens	64	13	215	46	279	59
Whatcom	10				10	
Whitman	9				9	
	207	26	333	64	540	90
Total, 1940	363	66	2,384	654	2,747	720

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

Ore totaling 1,171,674 tons (95 percent of the State output) in 1941 was produced from six properties. This total includes copper ore from the Holden property in Chelan County; zinc-lead ore from the Pend Oreille, Metaline, and Grandview properties in Pend Oreille County; and gold ore from the Knob Hill and Mountain Lion properties in Ferry County. Development work on these six properties included 87,008 feet of diamond drilling and 4,826 feet of churn drilling; development work was also reported at several smaller properties in the State.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Washington in 1941, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	32	178,121	37,508	175,011	56,423	3,090	
Dry and siliceous gold-silver ore	5	87	32	1,216	380	1,900	
Dry and siliceous silver ore	8	2,492	53	10,723	1,234	1,322	
	45	180,700	37,593	186,950	58,043	6,312	
Copper ore	6	694,565	46,034	202,091	17,313,000		
Lead ore	3	152		360		112,830	
Zinc-lead ore	7	363,092	9	12,539	957	7,686,858	28,640,000
Total, lode mines	61	1,238,509	83,636	401,940	17,372,000	7,806,000	28,640,000
Total, placers	56		540	90			
	117	1,238,509	84,176	402,030	17,372,000	7,806,000	28,640,000
Total, 1940	171	1,166,798	82,136	365,175	19,224,000	5,110,000	23,120,000

METALLURGIC INDUSTRY

Lode mines in Washington produced 1,238,509 tons of ore in 1941, treated as follows: 1,063,076 tons in straight concentrating mills, 135,290 tons at cyanide plants, 694 tons at amalgamation plants, and 39,449 tons shipped crude to smelters.

Amalgamation plants.—Ten straight amalgamation plants and one amalgamation and concentration plant treated 694 tons of dry gold ore in 1941. The Boundary Red Mountain property in Whatcom County was the chief producer.

Cyanidation mills.—The 400-ton cyanidation-concentration plant of Knob Hill Mines, Inc., at Republic, Ferry County, treated the bulk of the gold ore cyanided in 1941; the plant treated gold ore from the Knob Hill and Mountain Lion mines. The First Thought Mine Corporation treated gold ore from the First Thought mine in the Orient district, Stevens County, in its 50-ton plant. These two mills treated a total of 105,218 tons of gold ore and reported the consumption of 7,675 pounds of sodium cyanide (91-percent grade), 163,800 pounds of calcium cyanide, 29,500 pounds of zinc dust, and 1,371,800 pounds of lime.

Concentration mills.—A total of 1,063,076 tons of ore was treated at 13 flotation mills, as follows: 693,937 tons of copper ore treated at 4 plants, 363,092 tons of zinc-lead ore at 4 plants, 3,747 tons of gold ore at 4 plants, and 2,300 tons of silver ore at 1 plant.

Details of the treatment of all ore produced in Washington in 1941 are given in the following tables.

Mine production of metals in Washington in 1941, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	694	777	363			
Ore cyanided	135,290	6,582	16,996			
Concentrates smelted	71,871	65,448	329,832	17,155,667	7,689,648	28,640,000
Ore smelted	39,449	10,829	54,749	216,333	116,352	
Placer		540	90			
		84,176	402,030	17,372,000	7,806,000	28,640,000
Total, 1940		82,136	365,175	19,224,000	5,110,000	23,120,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1941, by types of mills and by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal		
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)
AMALGAMATION MILLS						
Chelan	76	75	14			
Ferry	13	228	217			
Okanogan	105	233	118	5	3	8
Whatcom	500	241	14			
	694	777	363	5	3	8
Total, 1940	1,418	568	161			
CYANIDATION MILLS						
Ferry	123,290	5,254	16,205	3,590	18,969	109,818
Stevens	12,000	1,328	791			
	135,290	6,582	16,996	3,590	18,969	109,818
Total, 1940	145,582	12,154	39,676	515	670	6,722
Grand total: 1941	135,984	7,359	17,359	3,595	18,972	109,826
1940	147,000	12,722	39,837	515	670	6,722

Mine production of metals from concentrating mills in Washington in 1941, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	687,343	35,330	45,910	175,853	16,730,900		
King	750	93	102	382	786	1,690	
Okanogan	2,795	184	280	302	35,286		
Pend Oreille	361,041	31,596		10,807		7,637,900	28,402,000
Snohomish	5,807	349	84	12,318	173,779	700	
Stevens	5,138	702	60	20,264	214,706	48,958	238,000
Whatcom	202	22	40	80	210	400	
	1,063,076	68,276	46,476	220,006	17,155,667	7,689,648	28,640,000
Total, 1940	972,848	64,856	53,164	238,706	18,958,139	4,993,708	23,120,000

Gross metal content of concentrates produced from ores mined in Washington in 1941, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	3,721	19,177	110,407	1,343	3,985	
Dry silver	89	49	8,917	392	1,320	
Copper	36,178	46,213	197,969	17,682,675	71,953	
Lead	5,396	4	11,671	649	7,852,349	411,631
Zinc	26,487	5	868	800	659,302	32,083,489
	71,871	65,448	329,832	17,685,859	8,588,909	32,495,120
Total, 1940	65,371	53,834	245,428	19,544,488	5,621,267	30,885,462

Mine production of metals from Washington concentrates shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	35,330	45,910	175,853	16,730,900		
Ferry	3,590	18,969	109,818			
King	93	102	382	786	1,690	
Okanogan	189	283	310	35,286		
Pend Oreille	31,596		10,807		7,637,900	28,402,000
Snohomish	349	84	12,318	173,779	700	
Stevens	702	60	20,264	214,706	48,958	238,000
Whatcom	22	40	80	210	400	
	71,871	65,448	329,832	17,155,667	7,689,648	28,640,000
Total, 1940	65,371	53,834	245,428	18,958,139	4,993,708	23,120,000

BY CLASSES OF CONCENTRATES

Dry gold	3,721	19,177	110,407	1,164	2,090	
Dry silver	89	49	8,917	300	700	
Copper	36,178	46,213	197,969	17,153,246		
Lead	5,396	4	11,671	586	7,537,168	
Zinc	26,487	5	868	371	149,690	28,640,000
	71,871	65,448	329,832	17,155,667	7,689,648	28,640,000

Gross metal content of Washington crude ore shipped to smelters in 1941, by classes of ore

Class of ore	Ore (short tons)	Gross metal content			
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous gold	38,390	10,755	47,062	24,087	1,644
Dry and siliceous gold-silver	87	32	1,216	478	3,024
Dry and siliceous silver	192	4	1,806	1,081	1,072
Copper	628	38	4,305	200,900	
Lead	152		360		116,107
	39,449	10,829	54,749	226,546	121,847
Total, 1940	46,950	12,833	79,190	277,697	125,311

Mine production of metals from Washington crude ore shipped to smelters in 1941, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Chelan	73	60	24	100	
Ferry	37,453	10,099	47,152	200	
King	67	9	757	314	610
Okanogan	906	511	1,313	19,714	1,600
Pierce	3	3	14		100
Snohomish	594	38	4,273	190,721	
Stevens	259	21	1,092	3,594	114,042
Whatcom	79	87	86	590	
Yakima	15	1	38	1,100	
	39,449	10,829	54,749	216,333	116,352
Total, 1940	46,950	12,833	79,190	265,861	116,292

BY CLASSES OF ORE

Dry and siliceous gold	38,390	10,755	47,062	20,141	1,000
Dry and siliceous gold-silver	87	32	1,216	386	1,900
Dry and siliceous silver	192	4	1,806	934	622
Copper	628	38	4,305	194,872	
Lead	152		360		112,830
	39,449	10,829	54,749	216,333	116,352

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1941, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)		Silver (fine ounces)		Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Lode	Placer				
Asotin County:											
Snake River		13			129		21				$4,530
Benton County:											
Columbia River		5			27						945
Chelan County:											
Chelan Lake	1		687,343	45,910		175,853		16,730,900			3,706,147
Peshastin Creek	4		149	135		38		100			4,764
Wenatchee River		3			3						105
Douglas County:											
Columbia River		2			2						70
Ferry County:											
Columbia River		1			5						175
Danville	1		193	434		412					15,483
Enterprise	1		84	1		630		100			495
Republic	9	1	160,479	34,115	4	172,350		100			1,316,737
Grant County:											
Columbia River		1			38		7				1,335
King County:											
Miller River	3		817	111		1,139		1,100	2,300		4,956
Kittitas County:											
Columbia River		1			2						70
Swauk		4			10		3				352
Yakima River		2			7						245
Okanogan County:											
Cascade	1		100	47		38					1,672
Columbia River		4			5						175
Loomis-Oroville	2		8	5		284					377
Methow	6		3,604	906		1,253		54,800	700		39,107
Myers Creek and Mary Ann Creek	3		94	69		166		200	900		2,608
Similkameen River		3			4						140
Pend Oreille County:											
Metaline	3	2	361,041		3	10,807			7,637,900	28,402,000	2,573,300
Pierce County:											
Mount Rainier	1		3	3		14			100		121
Snohomish County:											
Index	1		3,826	69		6,774		320,200			45,016
Stilaguamish	1		2,300	49		8,917		300	700		8,131
Sultan	1	2	268	3	3	886		43,900			6,020
White Horse Mountain	1		7	1		14		100			57
Stevens County:											
Bossburg	2		155			696		400	4,300	14,000	1,837
Chewelah	1		1,587	49		17,962		110,900			27,574
Columbia River		9			279		59				9,807
Colville	1		96			31			9,600	18,000	1,919
Deer Trail	4		21	3		734			6,300		986
Kettle Falls	1		1			76					54
Northport	4		1,983	10		1,274		1,000	142,800	206,000	24,964
Orient	2		12,028	1,345		796					47,641
Springdale	1		1,526	2		578		106,000			12,989
Whatcom County:											
Mount Baker	2		501	243		14					8,515
Slate Creek	3	2	280	125	10	166		800	400		4,960
Whitman County:											
Snake River		1			9						315
Yakima County: Summit	1		15	1		38		1,100			192
Total Washington	61	56	1,238,509	83,636	540	401,940	90	17,372,000	7,806,000	28,640,000	7,874,886

Comment on districts with small output has been omitted owing to lack of space.

ASOTIN COUNTY

Most of the output of gold from Asotin County in 1941 came from the operations of three small dragline and washer plants on Snake River.

BENTON COUNTY

The Benton County output in 1941 was derived from several small sluicing operations and one dragline working placers along the Columbia River near Paterson and Richland.

CHELAN COUNTY

Chelan Lake district.—The Holden property of the Howe Sound Co. was again the leading producer of gold, silver, and copper in Washington. Although the ore milled totaled 687,343 tons in 1941—almost equal to the 687,429 tons milled in 1940—the output of metals declined because a lower grade of ore was treated. In 1941 the grade of ore averaged 0.08 ounce of gold and 0.310 ounce of silver to the ton, 1.30 percent copper, and 0.88 percent zinc. The copper concentrates produced averaged about 1.30 ounces of gold and 5 ounces of silver to the ton and 24 percent copper. Mine development included sinking 150 feet of vertical and 377 feet of inclined shaft and driving 14,263 feet of drifts and 2,605 feet of raises, besides 44,139 feet of diamond drilling. The 2,000-ton company concentrator operated continuously in 1941 at slightly above rated capacity; a cyanide plant that was to start operations in January 1942 was added to the concentrator.

Peshastin Creek District.—Several small lots of crude gold ore were shipped to smelters in 1941, chiefly from the Old Blewett and Polepick mines.

DOUGLAS COUNTY

Gold recovered from bars along Columbia River by sluicing was the entire metal output of Douglas County in 1941.

FERRY COUNTY

Danville district.—Production of gold at the Morning Star mine from ore shipped to smelters and ore amalgamated increased in 1941.

Enterprise district.—A small amount of crude silver ore from the Silver Bell property was shipped to Tacoma for smelting in 1941.

Republic district.—The entire output of gold, silver, and copper in 1941 came from siliceous gold ore; 123,290 tons were treated by cyanidation and 10 tons by amalgamation, and 37,179 tons were shipped crude to a smelter. All the ore from the Knob Hill and Mountain Lion groups, operated by Knob Hill Mines, Inc., was treated in the 400-ton cyanide-flotation plant at the Knob Hill mine, producing 3,590 tons of gold concentrates in addition to cyanide bullion. Most of the crude ore from the Republic district, shipped for smelting, came from company and leasing operations on properties of the Aurum Mining Co. Other important shippers of crude ore were Golden Valley, Inc., operating the Valley claim; the Eureka

Mining & Milling Co., operating its Blaine-Republic properties on company and leasing accounts; Flag Hill Mines, operating the Scalawag mine; and operators of the South Penn property. A small amount of placer gold was recovered by sluicing on Columbia River.

GRANT COUNTY

All gold produced in Grant County during 1941 was recovered by the dry-land dredge operated by Miller Bros. at Chinaman Bar on Columbia River.

KING COUNTY

Most of the gold from King County in 1941 was contained in gold concentrates produced from gold ore treated in the 75-ton flotation mill at the Apex property. Small lots of siliceous gold-silver and siliceous silver ores were shipped from the Coney Basin and Cleopatra properties, respectively, for smelting.

KITTITAS COUNTY

Swauk district.—Several small sluicing operations produced placer gold from Swauk Creek in 1941.

Yakima River district.—A small amount of placer gold was recovered by sluicing on Yakima River.

OKANOGAN COUNTY

Cascade district.—The Bodie group near Wauconda, treating gold ore by amalgamation and concentration, produced the entire output of the Cascade district in 1941.

Loomis-Oroville district.—Two small lots, one of gold ore and the other of gold-silver ore, comprised the output of the Loomis-Oroville district in 1941.

Methow district.—The Methow Gold Corporation treated ore by amalgamation in the 40-ton Red Shirt mill and was the leading producer in the Methow district in 1941. Other producers were the New London, Highland Light & Hidden Treasure, Gold Crown, Minnie, and Gold Coin properties.

Myers Creek and Mary Ann Creek district.—Gold ore from the Mother Lode property represented the bulk of the output in 1941.

PEND OREILLE COUNTY

Metaline district.—The Pend Oreille County metal output increased in value from $1,712,157 in 1940 to $2,573,300 in 1941, owing chiefly to greater output of lead and zinc. The Pend Oreille Mines & Metals Co. operated the Josephine group the entire year and milled an average of 661 tons of ore a day in its 700-ton flotation mill. The company produced about 56 percent of the zinc and about 49 percent of the lead output of the Metaline district. The average content of the zinc-lead ore milled in 1941 was about 1 percent lead and 5 percent zinc. Development work reported by the company totaled 500 feet of incline, 1,701 feet of drifts, 485 feet of raises, and 18,067 feet of diamond drilling. The remainder of the zinc and lead output of the district was contained in zinc and lead concentrates produced by the 450- to

500-ton Grandview flotation mill, which treated ore from properties of the Metaline Mining & Leasing Co. and the American Zinc, Lead & Smelting Co. The crushing and classifier sections of the Grandview mill were enlarged, thereby increasing the milling capacity from 450 tons a day to 500 tons. Placer gravels yielded a small amount of gold.

PIERCE COUNTY

A small lot of gold ore was shipped crude to Tacoma in 1941 from the Silver Creek property in the Mount Rainier district.

SNOHOMISH COUNTY

Index district.—The Sunset Cooperative Mining Co. shipped copper concentrates and some crude ore to Tacoma for smelting in 1941, surpassing its 1940 production by more than 60 percent. The company operated its 150-ton flotation mill until November, when the Kromona Mines Corporation assumed control of the property.

Stilaguamish district.—Silver concentrates were shipped to Tacoma in 1941 for smelting, from properties operated by the Ore Recoveries Corporation at Silverton.

Sultan district.—The Kromona Mines Corporation operated the Florence Rae property in 1941 and shipped crude copper ore to Tacoma for smelting. A small amount of placer gold was recovered by sluicing along Sultan River.

STEVENS COUNTY

Bossburg district.—Small lots of zinc-lead ore, from the Silver Trail and Young America mines, treated in the Budd custom mill at Kettle Falls (Kettle Falls district) comprised the output of the Bossburg district in 1941. The Budd mill, owned by Ark Mines, is a 40-ton flotation mill.

Chewelah district.—The Chinto Mining Co., treating ore from company properties, in its 25-ton flotation mill, produced copper concentrates that yielded the metal output of the Chewelah district in 1941.

Columbia River district.—The Columbia River district of Stevens County was the largest producer of placer gold in the State in 1941. The bulk of the gold was recovered from properties along Columbia River operated by R. H. Fish and the Harvey R. Cline Co., both using mechanical equipment.

Colville district.—A small lot of zinc-lead ore from the Smokey Bullion mine was treated in the Budd custom mill and yielded the entire metal output of the Colville district in 1941.

Deer Trail district.—Several small lots of silver-lead ore were shipped crude to a smelter in 1941.

Northport district.—The Sierra Zinc Co. started production at the Blue Ridge mine in October 1941 and produced the bulk of the 1941 metal output of the Northport district. The company erected a 50-ton mill (crushing capacity, 100 tons) on the property in 1941. The remainder of the district output consisted of lead ore shipped crude to a smelter from the Electric Point and Gladstone Mountain mines and a small lot of silver ore from the Frisco-Standard mine.

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Orient district.—The First Thought Mine Corporation treated about 12,000 tons of siliceous gold ore in its 50-ton cyanidation mill and produced the bulk of the metal output of the Orient district in 1941.

Springdale district.—Ore from the Lucky Boy mine (only producer in the Springdale district in 1941) was treated in the Deer Trail 100-ton flotation mill and yielded copper concentrates; in addition, a small lot of ore was shipped crude to Tacoma.

WHATCOM COUNTY

Mount Baker district.—Ore from the Boundary Red Mountain mine, treated by amalgamation, contained most of the gold produced in the Mount Baker district in 1941.

Slate Creek district.—The bulk of the Slate Creek district output came from gold ore shipped crude to Tacoma from the Azurite property and from gold concentrates produced by the Slate Creek Mining Co. in its 75-ton flotation mill. A little gold was recovered from placers on Slate Creek by sluicing.

WHITMAN COUNTY

Snake River district.—A few ounces of gold were recovered from the Indian Bar placer on Snake River by sluicing.

YAKIMA COUNTY

Summit district.—A small lot of copper ore was shipped crude to Tacoma from the Chinook mine.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By CHAS. W. HENDERSON AND S. A. GUSTAVSON

SUMMARY OUTLINE

Lode and placer mines in Wyoming in 1941 yielded—in terms of recovered metals—478 fine ounces of gold, 94 fine ounces of silver, and 8,000 pounds of copper. Of this total, 447 ounces of gold and 50 ounces of silver were recovered from placer mining, the bulk of it by two dry-land dredge operations in the Atlantic City district of Fremont County; small hand-sluicing or panning operations—one in Albany County, two in Carbon County, and seven in Fremont County—supplied the remaining placer output.

No large lode-mining operations were carried on in the State to recover gold, silver, copper, or lead in 1941. Eight small lode mines, none of which shipped or treated over 40 tons of crude ore, yielded—in terms of recovered metals—31 fine ounces of gold, 44 fine ounces of silver, and 8,000 pounds of copper. A total of 75 tons of crude ore was treated in four small amalgamation mills—three in Fremont County and one in Johnson County—which recovered 10 fine ounces of gold and 4 fine ounces of silver. A total of 42 tons of copper ore and 42 tons of dry gold ore from three mines in Carbon County and one mine in Platte County (yielding 21 fine ounces of gold, 40 fine ounces of silver, and 8,000 pounds of copper) was shipped to the Garfield (Utah) smelter.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1937-41

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063
1941	35.00	[6] .711+	.118	.057	.075

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1937: Yearly average weighted Treasury buying price for newly mined silver, 1938-41 Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787 [6] $0.71111111

The following table shows the annual output of ore from lode mines producing gold, silver, copper, and lead and the quantity and value of the metals recovered from both lode and placer mines in Wyoming from 1937 to 1941; it also gives the total production of metals from 1867 to 1941. About three-fourths of the total recorded value of the four metals is in copper, most of which was mined before 1924 in the Encampment district, in Carbon County, and the Hartville district, originally in Laramie County, now in Platte County.

Mine production of gold, silver, copper, and lead in Wyoming, 1937–41, and total, 1867–1941, in terms of recovered metals

Year	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1937	17	1,776	$62,160	203	$157					$62,317
1938	581	798	27,930	328	212					28,142
1939	57	583	20,405	75	51					20,456
1940	813	740	25,900	114	81	4,000	$452			26,433
1941	159	478	16,730	94	67	8,000	944			17,741
1867–1941	(1)	77,891	1,834,513	74,580	51,715	(2) 16,325	5,684,048	(2) 8	$568	7,570,844

[1] Figures not available. [2] Short tons.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, and copper in Wyoming in 1941, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated	Gold			Silver			Copper	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total		
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	
Albany		1			2	2					$70
Carbon	3	2	81	21	3	24	27	1	28	6,000	1,568
Fremont	3	9	60	8	442	450	3	49	52		15,787
Johnson	1		15	2		2	1		1		71
Platte	1		3				13		13	2,000	245
	8	12	159	31	447	478	44	50	94	8,000	17,741
Total, 1940	9	28	813	18	722	740	41	73	114	4,000	26,433

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Centennial district.—The only mining operations in the Centennial district in 1941 were those incident to development or assessment work.

Douglas Creek district (Holmes, Keystone).—A small lot of placer gold was recovered by Ira J. Knisley on the west branch of Little Beaver Creek. Development and assessment work were the only other mining operations carried on in the Douglas Creek district. Pete Erickson, of Holmes, did development work on the Lucky Strike property. The Multi Metals Corporation also did development work and made tests for the treatment of ore from its Gold Crater group of claims near Keystone.

BIG HORN COUNTY

There was no metal production from Big Horn County in 1941. Some sampling for gold of bench gravel on the Big Horn River, about 7 miles north of Kane, was done by George E. Frame.

CARBON COUNTY

Elkhorn Mountains district.—Assessment work and some sampling were done by the Golden Sun Mining Syndicate on the Vulcan group of claims; a small shipment of gold ore was sent to the Garfield (Utah) smelter of the American Smelting & Refining Co. Shull, Johnson & Hoggard made a small shipment of copper ore to the Garfield smelter. Development work was carried on at the Silent Six group by C. H. Ashley, of Encampment, and at the Hub group by Joe McCarthy, of Livermore, Colo.

Encampment or Upper Platte district.—The Golden Clover claim was developed further, and a few tons of dry gold ore were shipped to the Garfield (Utah) smelter.

Savery Creek district.—Sluicing of about 700 cubic yards of gravel in Savery Creek by John Malten yielded 2½ ounces of gold.

FREMONT COUNTY

Atlantic City district.—The holdings of Crawford Bros., including the complete dry-land washing plant and all leases of the E. T. Fisher Co., were purchased in November 1940 by C. E. Gish of Farnam, Nebr. Gish operated the plant in 1941 and treated about 80,000 cubic yards of gravel, from which 224 fine ounces of gold and 26 fine ounces of silver were recovered; the average fineness of the bullion was 0.890 in gold and 0.105 in silver, the same as in 1940. The placering was carried on chiefly on the Timba-Bah Mining Co. property about 5 miles below Atlantic City, largest single producer of gold and silver in the State in 1941. John E. Whisenand's placer operation on Sweetwater River in the vicinity of Atlantic City, worked by a 3-cubic yard dragline and a washing plant, ranked second in output of gold and silver. His bullion had an average fineness of 0.894 in gold and 0.083 in silver. The plant was shut down and moved to Farson, Wyo., in the fall of 1941. There were small hand-operated placers in Big Atlantic Gulch, Meadow Gulch, and Rock Creek.

Roy A. Cowden, of Atlantic City, operated the Gold Leaf and Mint lode-mining claims and treated 40 tons of ore in a 5-ton Gibson amalgamation mill, producing 5½ ounces of gold bullion which was sold to the Denver Mint. Jacob Stevenson and J. C. Gibson operated the Caribou mine, did development work, and treated 10 tons of ore. J. Don Birch operated the St. Louis mine and the Birch 10-ton amalgamation mill; 10 tons of ore were treated and yielded 2.84 ounces of fine gold and 0.48 ounce of fine silver.

Copper Mountain district.—Using a portable mechanical placer machine, H. B. Crawford in sampling and testing placer ground handled 30 tons of old tailings and stream gravel in Birdseye Creek below the Gold Nugget mine on Copper Mountain; about 1 ounce of fine gold was recovered.

JOHNSON COUNTY

The Powder River Mining Corporation treated a few tons of ore from the Powder River mine. The property is in sec. 20, T. 47 N., R. 85 W.

PLATTE COUNTY

Oscar Alexander made a shipment of 3 tons of copper ore to the Garfield (Utah) smelter. The Colorado Fuel & Iron Co. produced no copper ore at its Sunrise iron mine in 1941.

TETON COUNTY

Some sampling work was done on the Mercury placer on Snake River about 7 miles southeast of Moran, but no product was marketed.

SECONDARY METALS—NONFERROUS

By F. H. Wright and J. H. Schaum [1]

SUMMARY OUTLINE

GENERAL SUMMARY

All previous records for annual recovery of secondary nonferrous metals were broken in 1941. The value of economically important nonferrous metals recovered from scrap, as metal and in alloys and chemicals, totaled $348,377,389 in 1941 compared with $242,789,445 (revised) in 1940. Metals recovered from new scrap that entered the market as a byproduct of manufacturing operations comprised $143,114,982 of the total, and metals recovered from old and obsolete salvage materials were valued at $205,262,407.

Salient statistics of nonferrous secondary metals recovered in the United States, 1940–41

Metal	New scrap		Old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940						
Aluminum	[1] 34,556	[1] $12,612,940	[1] 45,806	[1] $16,719,190	[1] 80,362	[1] $29,332,130
Antimony	245	68,600	11,176	3,129,280	11,421	3,197,880
Copper	198,156	44,783,256	333,890	75,459,140	532,046	120,242,396
Lead	33,763	3,376,300	226,583	22,658,300	260,346	26,034,600
Magnesium	(2)	(2)	(2)	(2)	(2)	(2)
Nickel	2,184	1,528,800	1,968	1,377,600	4,152	2,906,400
Tin	12,736	12,690,150	20,486	20,412,251	33,222	33,102,401
Zinc	[1] 157,809	[1] 19,883,934	64,204	8,089,704	[1] 222,013	[1] 27,973,638
		[1] 94,943,980		[1] 147,845,465		[1] 242,789,445
1941						
Aluminum	63,744	20,704,051	43,113	14,003,102	106,857	34,707,153
Antimony	57	15,960	21,572	6,040,160	21,629	6,056,120
Copper	313,697	74,032,492	412,699	97,396,964	726,396	171,429,456
Lead	17,136	1,953,504	380,280	43,351,920	397,416	45,305,424
Magnesium	1,737	833,760	15	7,200	1,752	840,960
Nickel	3,181	2,226,700	2,134	1,493,800	5,315	3,720,500
Tin	12,427	12,926,565	29,606	30,796,161	42,033	43,722,726
Zinc	202,813	30,421,950	81,154	12,173,100	283,967	42,595,050
		143,114,982		205,262,407		348,377,389

[1] Revised figures. [2] Data not available.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce

Although the full effect of all-out war production was not felt in the secondary metals industry during 1941, there were many instances of change. Turnings and clippings of aluminum, magnesium, copper, and brass were produced in tremendous quantities but for the most part were routed back to rolling mills. Denial of export licenses for nickel scrap created the need for recovery facilities in the United States, and several plants expanded their operations.

The better grades of all scrap metals were always in demand during 1941, but some of the lower grades suffered because they could not be used in products that had to meet the rigid specifications of armament production. Unalloyed copper scrap and high-tin bronze supplies fell far short of requirements. It is interesting to note that more of almost every type of scrap was consumed in 1941 than in 1940.

Aluminum and zinc scrap held the spotlight in January and February, with many instances of scrap prices far above those of primary metal, owing to surging business activity and a demand exceeding primary production facilities. Both aluminum and zinc scrap virtually disappeared from the market when the first official scrap price ceilings were imposed in March, and normal flow was not resumed until midsummer.

Smelters and ingot makers experienced difficulty in finding sufficient copper, brass, and bronze scrap during most of 1941, but they had less trouble after a large part of the competition from foundries was removed by priority control in October. Even though some dealers had difficulty in disposing of low-copper-bearing materials, consumption of copper-bearing scrap and residues was almost four times that of 1940.

Most nonferrous scrap-metal prices averaged 1 cent to 1.8 cents a pound higher in 1941 than in 1940.

SCOPE OF REPORT

New features were added to the canvass of nonferrous scrap-metal consumers in 1941. Remelters, smelters, and refiners were asked to report the weight and composition of metals and alloys produced from scrap, and manufacturers and foundries, including brass mills, aluminum rolling mills, and chemical works, were asked to list their products and report the secondary metal contents.

Secondary magnesium rose to a position of economic importance during 1941 and is reported in this chapter for the first time.

In all, 344 plants were classified as remelters, smelters, or refiners of nonferrous scrap metals in 1941. Some of these plants specialized in one base metal, whereas others combined a variety of functions and consumed many types of scrap.

Consumption of purchased nonferrous scrap metals was reported by 1,192 manufacturers and foundries (including brass mills and chemical works) in 1941. Many foundries and manufacturers made their initial entry into the scrap market in 1941 in search of materials to fill rated orders, and other consumers who used scrap during the first half of the year were unable to obtain priorities for further purchases.

Each table of secondary metals recovered shows the total quantity of each element reclaimed directly as metal or in chemical compounds and, in addition, the quantity of that element reclaimed in alloys recovered from certain types of alloy scrap. The fact that a metal

is recovered in one type of alloy scrap does not necessarily mean that the final product was an alloy of the same class. For example, tin recovered in solder (a lead alloy) might emerge from the plant as an alloying element in bronze ingot. From the foregoing it is obvious that there is no basis for direct comparison between the tables of metal "recovered" and the tables of metal products, introduced in this chapter for the first time.

SECONDARY ALUMINUM

The quantity of secondary[2] aluminum recovered from scrap totaled 106,857 short tons valued at $34,707,153 in 1941 compared with 80,362 tons valued at $29,332,130 in 1940 (revised figures). The value was computed at 16.24 cents a pound of weight recovered in 1941 compared with 18.25 cents in 1940.

Secondary aluminum recovered in the United States, 1940–41, in short tons

	1940 [1]	1941
As metal	5,620	8,308
Aluminum alloys produced and recovered from aluminum scrap	74,742	97,614
In chemical products:		
Aluminum chloride	(2)	784
Aluminum sulfate	(2)	151
	80,362	106,857
From new scrap	34,556	63,744
From old scrap	45,806	43,113

[1] Revised figures. [2] Data not available.

The 8,308 tons of secondary aluminum recovered as metal appeared on the market as 3,449 tons of pure aluminum (98.5 percent) ingot, 1,663 tons of aluminum powder, 931 tons of pure aluminum castings, and 2,265 tons in commercial shapes produced by rolling mills.

The 97,614 tons of secondary aluminum alloys recovered from aluminum scrap appeared in such products as aluminum-alloy ingot, alloy castings, zinc-base die-cast alloys, and aluminum bronze.

Production of secondary aluminum [1] and aluminum-alloy products in the United States, 1940–41, gross weight, short tons

	1940	1941
Secondary aluminum ingot [2]		
Pure aluminum (98.5 percent)	4,679	3,449
95.5 (silicon)	5,679	4,014
Other aluminum-silicon alloys	1,539	3,356
No. 12 aluminum	17,519	21,708
Other aluminum-copper alloys	1,613	6,477
Aluminum-copper-silicon alloys	12,334	10,113
Steel-mill ingot and shot	19,427	24,212
Die-casting alloys	2,552	4,431
Aluminum hardeners	1,340	4,747
Miscellaneous	1,807	1,426
	68,489	83,933
Aluminum powder	(3)	1,663
Aluminum castings	(3)	9,851
Aluminum in chemical products	(3)	935

[1] In addition to the secondary aluminum produced, 670 tons of aluminum were recovered from aluminum scrap in zinc die-casting alloys, and 291 tons in aluminum bronze; 14,221 tons were combined with primary aluminum in the products of aluminum rolling mills.
[2] Gross weight of alloys, including copper, silicon, and other added elements; total secondary ingot contained 3,718 tons of primary aluminum in 1940 and 1,038 tons in 1941.
[3] Data not available.

[2] The term "secondary aluminum" is used in the broad sense covering aluminum and aluminum alloys, including the weight of alloy constituents, such as copper, silicon, magnesium, etc.

Thirteen chemical-producing companies recovered 784 tons of aluminum in aluminum chloride and 151 tons in aluminum sulfate. The second half-year activity in chemical production approximately doubled that of the first half.

Despite an erratic production rate, 80 secondary ingot makers produced 83,933 tons of various grades of ingot, resulting in a 23-percent increase over the 1940 output, which was still far below the maximum capacity available.

The average monthly production of secondary ingot was 6,994 tons. Monthly output rose from about 8,000 tons in January and February to almost 10,000 tons in March, then fell abruptly to 4,500 tons in May, when dealers withdrew from the market after price ceilings had been set. Production became stabilized toward the end of 1941 as confidence returned to the trade.

New scrap from the fabrication of aluminum sheet and forgings was largely routed back to aluminum rolling mills for most efficient recovery of the low-alloy metal consumed in aircraft production. In 1941, 14,221 short tons of aluminum were thus recovered from scrap by working the metal in with primary aluminum.

The quantity of aluminum recovered from old scrap in 1941 was slightly less than recovery from old scrap in 1940, but recovery from new scrap increased 84 percent.

Consumption of purchased aluminum scrap in the United States in 1941, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Aluminum rolling mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
Pure clippings, wire, and foil	2,565	1,083	3,184	16	869	849	8,566
Castings and forgings	4,320	23,401	28		223	5,466	33,438
Alloy sheet	9,365	1,447	625	3	1,331	68	12,839
Scrap sheet and sheet utensil	1,050	11,734	10,510	78	103	888	24,363
Borings and turnings	30,618		1,379		594		32,591
Die castings		169			34	38	241
Miscellaneous aluminum and dross	13,732	81	71		517	8	14,409
	61,650	37,915	15,797	97	3,671	7,317	126,447

The consumption of 126,447 tons of aluminum scrap in 1941 represents a 36-percent increase over 1940. About 79 percent of the scrap was used by 99 remelters, smelters, and refiners; 13 percent by 14 aluminum rolling mills; and the remaining 8 percent by 997 foundries and miscellaneous manufacturers.

Of the total aluminum scrap used in 1941, Ohio consumed 33 percent, Illinois 21 percent, Michigan 9 percent, New York 7 percent, California 6 percent, Pennsylvania 6 percent, Tennessee 5 percent, and all other States 13 percent.

As the sources of old scrap were depleted to some extent, the market in 1941 reflected its increased dependence on new scrap generated by manufacturers, and 64 percent of all scrap consumed was new. In 1940, new scrap constituted only 43 percent of the total

Remelters, smelters, and refiners proved the largest consuming group by taking 99,565 tons of aluminum scrap, a 29-percent rise over 1940. Although die castings, pure clippings, wire, and foil all revealed diminished usage, the 30,618 tons of borings and turnings consumed amounted to almost double the 1940 consumption. Virtually all of the scrap used by aluminum rolling mills was new scrap that was a byproduct of industrial fabrication. Foundries and miscellaneous manufacturers consumed only 10,988 tons of aluminum scrap, slightly less than in 1940. Early in 1942, an order was issued making it mandatory for all companies whose operations yielded more than 1,000 pounds of aluminum scrap a month to segregate all scrap produced.

Consumers' stocks of purchased aluminum-base scrap in the United States at end of year, 1940–41, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1940 [1]	Dec. 31, 1941
Castings and forgings	2,734	2,004
Sheet, turnings, clippings, etc.	3,690	6,070
Miscellaneous aluminum and dross	1,802	1,521
	8,226	9,595

[1] Revised figures.

The base price of primary aluminum ingot was reduced from 17 cents a pound to 15 cents a pound in October and averaged 16.50 cents for the year. The average price for the 98 percent pure secondary aluminum was about 17.36 cents.

Dealers' buying prices for scrap cast aluminum in New York averaged 10.76 cents a pound in 1941 compared with 8.95 cents in 1940. Prices averaged 13.97 cents in February, but March prices could not be averaged for lack of quotations. Following the announcement of official ceiling prices on March 25, the monthly average dropped to 11.00 cents in April and remained static until October, when an average of 9.36 cents a pound reflected the drop in price of both primary metal and scrap. Cast scrap averaged 9.37 cents in December.

Dealers' buying prices for new aluminum clippings in New York averaged 13.00 cents a pound in 1941 compared with 14.47 cents in 1940. From a peak of 16.88 cents averaged in March, the price dropped to the ceiling level of 13.00 cents, eased to 11.36 cents a pound in October, and ended the year with a December average of 9.37 cents.

Effective March 25, 1941, a dual price ceiling listing maximum prices for sale of aluminum scrap by maker, as well as for sale to consumer, was announced by the Office of Price Administration. Secondary ingot (98 percent pure) was fixed at 17 cents a pound, and scrap prices were set in relation to the prevailing rate for primary metal (17 cents a pound). The flow of aluminum scrap immediately dried up and did not resume normal volume until late in the summer of 1941.

Many secondary aluminum-ingot makers were shut down in April and May, and a few operated at reduced schedules. Nevertheless, ingot production during the first half of 1941 advanced 21 percent over the half-year rate in 1940.

On November 1, 1941, scrap-aluminum price ceilings were reduced to conform with the new 15-cent base price of primary metal, and the dual price schedule was abolished in favor of a single list of maximum sale prices. Secondary ingot was also reduced to 15 cents for 98-percent metal.

Aluminum scrap was placed under full priority control on June 10, 1941, but smelters did not receive an A-10 rating until the first of July.

The much publicized house-to-house aluminum-collection campaign in July netted 5,600 short tons of mixed scrap metals containing about 3,200 tons of recoverable aluminum.

Imports of aluminum scrap into the United States were only 26 tons for the first 9 months of 1941 compared with 648 tons in all of 1940. No figures on exports were available for publication.

SECONDARY ANTIMONY

A total of 21,629 short tons of secondary antimony valued at $6,056,120 was recovered in 1941 compared with 11,421 tons valued at $3,197,880 in 1940. The value in both years was computed at 14 cents a pound, the average price for ordinary brands of American-grade antimony. The expanded recovery of antimony represented an increase of almost 90 percent over 1940.

Secondary antimony recovered in the United States, 1940–41, in short tons

	1940	1941
In lead-base alloys [1]	11,073	21,337
In tin-base alloys	348	292
	11,421	21,629
From new scrap	245	57
From old scrap	11,176	21,572

[1] Includes antimony recovered as metal and in oxide and other compounds. 867 tons of antimony were recovered in antimonial lead produced at primary lead refineries in 1940 and 532 tons in 1941

The rise in secondary antimony was entirely attributable to the 21,337 tons recovered in lead-base alloys. There was a 16-percent decline in antimony recovered in tin-base alloys—from 348 tons in 1940 to 292 tons in 1941. Nearly all of the antimony was recovered in old scrap. Only 2,113 tons (10 percent of the total) were recovered by consumers classified as manufacturers and foundries.

A table of the secondary lead and tin-base alloy products containing secondary antimony may be found in the section on Secondary Lead. Antimonial lead products yielded 77 percent of the secondary antimony recovered, including 10,820 tons contained in high antimonial lead (over 8 percent antimony). This latter type of antimonial lead is produced largely in conjunction with the recovery of refined lead from battery plates, when antimony slag is smelted to make a hard lead containing up to 16 percent antimony. The 21,629 tons of secondary antimony reported in 1941 were recovered in 371,809 tons of lead-base scrap and 4,725 tons of tin-base scrap. Battery-lead plates were the source of almost 60 percent of the total secondary antimony, and the remainder was supplied by type metal and type dross, hard lead, and bearing metals. The threatened

shortage of lead resulting from unusually heavy demand brought out large amounts of old battery plates.

Consumption of purchased antimony-bearing scrap in the United States in 1941 gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Lead-base scrap.					
Hard lead	539	37,693	117	234	38,583
Cable lead		21,779		70	21,849
Battery-lead plates		257,638		6,552	264,190
Mixed common babbitt	109	6,574		9,077	15,760
Type metals		15,483	11	3,858	19,352
Type-metal dross		10,551			10,551
Lead sludge		1,524			1,524
	648	351,242	128	19,791	371,809
Tin-base scrap.					
No. 1 pewter		371		40	411
Genuine babbitt	22	2,433	(1)	3	2,458
No. 1 babbitt	26	1,671	(1)	159	1,856
	48	4,475	(1)	202	4,725
	696	355,717	128	19,993	376,534

1 Less than 1 ton.

On January 13, 1942, the maximum price allowed for the antimony content of secondary antimonial lead was set at 14 cents a pound, but the factor was advanced to 15.50 cents a pound on March 31, 1942. The War Production Board placed antimony under full priority control, effective May 1, 1942.

SECONDARY COPPER AND BRASS

More than 1,000,000 short tons of purchased [3] copper and copper-base scrap were consumed in 1941. Copper recovered from scrap metals, including that in alloys, totaled 726,396 short tons valued at $171,429,456 in 1941 compared with 532,046 tons valued at $120,242,396 in 1940. The value was computed at 11.8 cents a pound in 1941, whereas the average price of 11.3 cents was used in 1940.

In all, 135,869 tons of copper were recovered in 1941 as essentially pure metal, most of which was refined electrolytically. Of the total copper recovered in copper-alloy products, yellow brass alloys contributed 234,191 tons (copper content), and alloys other than yellow brass supplied 346,532 tons of secondary copper. In addition to copper recovered as metal and in alloys, 9,804 tons were recovered from scrap metals in the form of chemicals.

Owing to greatly increased demand for clean copper scrap at foundries and secondary brass-ingot plants, recovery of refined copper from scrap at primary copper refineries decreased 15 percent from 117,669 short tons in 1940 to 99,675 tons in 1941.

3 The term "purchased scrap" includes scrap treated on toll as well as scrap transferred between plants of a single company It does not include home scrap reused in the plant in which it originated

Secondary copper recovered in the United States, 1940–41, in short tons

	1940	1941
As metal	170,839	135,869
In brass and other alloys	361,207	590,527
	532,046	726,396
As metal:		
At primary plants	117,669	99,675
At other plants	53,170	36,194
	170,839	135,869
In yellow brass	[1] 174,020	234,191
In alloys other than brass	[1] 177,756	346,532
In chemicals	9,431	9,804
	532,046	726,396

	1940	1941
In new scrap:		
Yellow brass	[1] 121,531	162,161
All other	[1] 76,625	151,536
	198,156	313,697
In old scrap:		
Yellow brass	52,489	72,030
All other	281,401	340,669
	333,890	412,699

[1] Includes some plant scrap at brass mills.

Analysis and production of secondary copper and copper-alloy products in the United States in 1941

Item produced from scrap	Approximate analysis (percent)						Gross weight produced during 1941 (short tons)
	Cu	Sn	Pb	Zn	Ni	Al	
Refined copper (electrolytic grade)	100						109,368
Casting copper	99						18,700
Copper sheet, rod, tubing, etc	99						3,855
Copper powder	98						2,493
Copper castings	98						1,453
Total unalloyed copper products							135,869
Brass and bronze ingots:							
Tin bronze	88	10		2			26,343
Leaded-tin bronze	88	6	1.5	4.5			29,404
Leaded red brass	85	5	5	5			91,389
Leaded semired brass	81	3	7	9			30,829
High-leaded-tin bronze	80	10	10				25,005
Do	84	6	8	2			8,658
Do	75	5	20				5,850
Leaded yellow brass	66	1	3	30			21,518
High-strength yellow brass	58			39		1	31,676
Manganese bronze	62			27		5	8,202
Aluminum bronze	89					10	4,261
Nickel silver	58	2	7	18	14		941
Do	65	4	3	5	22		2,205
Gilding metal	95			5			5,231
Low brass	80			20			1,129
Phosphor copper	85						2,542
Hardeners and special alloys	81						3,838
Total copper-alloy ingots							299,021
Brass and bronze sheet, rod, tubing, etc							[1] 308,407
Brass and bronze castings							[2] 152,637
Copper in chemical products (copper content)							9,804

[1] Gross weight of secondary brass and bronze in commercial shapes; includes 221,492 tons of copper, 1,200 tons of nickel, 4,166 tons of lead, 236 tons of tin, and 81,313 tons of zinc.

[2] Gross weight of secondary brass and bronze castings, includes 123,955 tons of copper, 1,424 tons of nickel, 9,087 tons of lead, 6,986 tons of tin, and 11,185 tons of zinc

As would be expected with expanded production of munitions added to a general upswing in manufacturing activity, secondary copper and copper in alloys recovered from new scrap in 1941 increased 58 percent over the 1940 figure. The 24-percent increase in recovery of copper in old scrap reflected the consumption of reserves of old copper and brass scrap brought out by an active market,

augmented by scrap-collection campaigns. Unalloyed copper scrap yielded 231,500 tons of secondary copper, which was recovered partly as refined metal, to a limited extent in copper chemical products, and to a greater extent in brass and bronze. Of this amount, 59,078 tons came from new unalloyed copper scrap and 172,426 tons from old unalloyed scrap.

No direct comparison may be made between the table of secondary copper "recovered" and the table of copper products. The tabulation of metal "recovered" includes copper contained in nickel-base, aluminum-base, and tin-base alloy scrap, as well as the copper recovered by direct addition of copper scrap to such items as secondary aluminum ingot or tin babbitts. The tabulation of copper and copper-alloy products lists the gross weight of secondary copper alloys, including both primary and secondary tin, lead, zinc, nickel, aluminum, and a small quantity of primary copper.

Refined electrolytic-grade copper was produced at 12 refineries, including 10 primary plants. Of the 109,368 tons of refined copper produced, 83 percent was supplied by 5 plants. Casting copper was produced at 21 plants, of which only 1 was a primary copper refinery.

Secondary brass and bronze ingots totaling 299,021 short tons were produced by 78 ingot-manufacturing plants representing 65 companies. Stocks of secondary ingot rose 12 percent from 12,269 tons on hand December 31, 1940, to 13,760 tons on hand December 31, 1941. Shipments in 1941 totaled 297,530 short tons.

Consumption of purchased copper scrap in the United States in 1941, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries: Brass mills		Manufacturers and foundries: Foundries and other manufacturers		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
No. 1 wire and heavy	18,368	42,688	14,126	8,850	2,590	15,542	102,164
No. 2 wire, mixed heavy, and light	10,465	92,175	12,426	1,501	2,689	17,607	136,863
Composition or red brass	35,004	70,480	3		404	59,762	165,653
Railroad-car boxes		1,943				39,159	41,102
Yellow brass	20,348	82,941	232,901	19,875	3,578	18,674	378,317
Auto radiators (unsweated)		45,438				873	46,311
Electrotype shells		1,655				548	2,203
Bronze	307	4,267	2,955		42	1,692	9,263
Nickel silver	765	1,204	6,798	197	96	69	9,129
Low brass	495	727	12,886	1,622		7,087	22,817
Aluminum bronze	133	355			3	1	492
Low-grade scrap and residues	60,773	29,030			45	8	89,856
	146,658	372,903	282,095	32,045	9,447	161,022	1,004,170

The gross weight of "purchased" copper and copper-alloy scrap consumed in 1941 was 1,004,170 short tons compared with 707,924 tons in 1940, a 42-percent increase. Of the total scrap used, 52 percent was consumed by 109 remelters, smelters, and refiners, 31 percent by 36 brass mills, and 17 percent by 1,028 foundries and miscellaneous manufacturers.

Aside from copper-bearing byproduct residues, the remelter, smelter, and refinery group treated comparatively little new scrap but con-

sumed two-thirds of all the old. Brass mills used minor quantities of old yellow brass and old clean copper but accounted for almost two-thirds of all the new scrap reported. Foundries and miscellaneous manufacturers confined virtually all of their purchases to old scrap.

Consumers' stocks of purchased copper-base scrap in the United States at end of year, 1940-41, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1940 [1]	Dec. 31, 1941
Unalloyed copper	15, 606	15, 004
Copper-base alloy	56, 283	53, 218
Low-grade scrap and residues	23, 733	34, 654
	95, 622	102, 876

[1] Revised figures.

Brass-ingot manufacturers placed a voluntary ceiling on their products early in 1941, but sale prices of foundry products were not controlled.

Maximum prices were set for brass mill scrap on July 22, 1941, in order that other consumers might be prevented from offering higher prices to draw new brass and commercial bronze scrap from the channel of most efficient recovery. On August 12, 1941, the price of electrolytic-grade copper was set at 12 cents, delivered Connecticut Valley. This was followed by ceilings on unalloyed copper scrap which placed the consumers' price of No 1 scrap at 10.75 cents, effective August 19, 1941.

Dealers' monthly average buying prices for No. 1 copper scrap at New York rose from 8.87 cents a pound in January to 9.60 cents in March, dropped to 8.99 in April, then rose to 10.03 cents in August. The dealers' buying price ceiling of 10 cents held throughout September, then prices declined to 9.37 cents in November and December. The average was 9.44 cents in 1941 compared with 8.20 cents in 1940. No. 1 composition scrap followed practically the same trends, averaging 9.41 cents a pound in 1941 compared with 7.68 cents in 1940.

The drop in scrap prices during October was occasioned by a revision in the copper price-ceiling order that abolished the dual price schedule and reduced the maximum selling price of No. 1 copper scrap to 10 cents but permitted the addition of transportation charges and certain quantity premiums. The further fall in November prices was the result of an order prohibiting delivery of brass ingot for nondefense uses.

Except for certain grades of brass mill scrap, copper-alloy scrap was free of formal price ceilings until February 27, 1942, when prices were set on 24 grades.

Although primary copper was first made subject to allocation on May 29, 1941, it was not until September 30, 1941, that the flow of copper scrap was brought under regulation. According to Supplementary Order M-9-b issued by the Director of Priorities, brass mill scrap was routed to brass mills as sole consumers, and dealers were prohibited from melting any type of copper or copper-alloy scrap. Deliveries of scrap to other than dealers required a preference rating showing that the material was needed for essential uses.

All types of copper scrap were in demand at the start of 1941, but continued light offerings led to the belief that dealers were holding scrap for an expected rise in price. Liquidation of copper and copper-base scrap was hastened in April, when producers of primary copper agreed to an informal ceiling of 12 cents for refined copper. Brass-ingot makers and custom smelters experienced difficulty in obtaining enough scrap of the better grades throughout 1941, but supplies of material of low copper content exceeded demand. Large purchases of scrap copper and brass were made early in August, when dealers again hurried to move accumulations before formal ceiling prices became effective. Flow of scrap was retarded immediately after the price ceilings were issued and did not increase noticeably until November.

General Imports Order M-63, effective December 27, 1941, required in part that scrap copper and brass be imported under the direction of the Metals Reserve Co Publication of import and export statistics was suspended at the end of September 1941.

Copper, brass, and bronze scrap were placed under export control on January 10, 1941. Effective February 3, 1941, a license was required for exporting materials containing over 15 percent copper.

Brass and copper scrap imported into and exported from the United States, 1940–41, in short tons

	1940	1941 (Jan -Sept.)
Brass scrap imported	1,232	4,688
Scrap copper imported	135	2,023
Brass scrap exported	5,887	681
Scrap copper exported	7,149	3,201

SECONDARY LEAD

The net weight of secondary lead recovered from scrap, including lead as metal and lead contained in alloys, totaled 397,416 short tons valued at $45,305,424 in 1941 compared with 260,346 short tons valued at $26,034,600 in 1940. The value was computed at 5.7 cents a pound in 1941 and 5.0 cents a pound in 1940.

The lead content of soft lead refined from scrap amounted to 75,264 tons, and the lead content of secondary antimonial lead was 206,521 tons in 1941. Lead recovered in other scrap-lead alloys, such as type metal, lead babbitts, and solders, totaled 88,200 tons, and lead recovered as a constituent of other alloy scrap, such as brass and bronze, came to 27,431 tons.

The total secondary lead recovered in all forms represented a 53-percent increase in 1941 compared with 1940.

The apparent drop in the quantity of lead recovered from new scrap—from 33,763 short tons in 1940 to 17,136 tons in 1941—was caused by a change in interpretation and not by any difference in the types of scrap consumed. In former years, certain drosses resulting from the actual use of type metals, as well as drosses produced in scrap-metal dealers' lead-scrap melting operations, were classed as new scrap. Further study has led to the belief that the drosses specified should be reclassified as old scrap. Very little "new" lead scrap

reaches commercial channels, owing to the fact that most of this material is easily prepared for reuse in the same plant.

Secondary lead recovered in the United States, 1940–41, in short tons

	1940	1941
As metal:		
At primary plants	16,588	13,454
At other plants	42,992	61,810
	59,580	75,264
In antimonial lead [1]	126,687	206,522
In other lead alloys	58,586	88,200
In alloys other than lead alloys	15,493	27,430
	260,346	397,416
From new scrap	33,763	17,136
From old scrap	226,583	380,280

[1] Includes 1[illegible],431 tons of lead recovered from secondary sources at primary plants in 1940 and 13,862 tons in 1941.

Production of secondary lead, tin, and lead and tin-alloy products in the United States in 1941, gross weight, in short tons

	Gross weight of product	Secondary metal content			
		Lead	Tin	Antimony	Copper
Refined pig lead	74,959	74,931	-	-	-
Soft lead castings	158	158	-	-	-
Lead pipe	133	133	-	-	-
Lead foil	42	42	-	-	-
	75,292	75,264	-	-	-
Refined pig tin	5,882	-	5,880	-	-
Tin foil	18	-	18		-
	5,900	-	5,898	-	-
Lead and tin alloy pigs					
Antimonial lead (to 2 percent antimony)	16,869	16,644	5	219	-
Antimonial lead (2 to 4 percent antimony)	37,456	33,270	55	1,325	-
Antimonial lead (4 to 8 percent antimony)	59,872	65,412	71	4,174	-
Antimonial lead (over 8 percent antimony)	102,156	91,194	123	10 820	-
Common babbitt	15,824	12,723	1 200	1,276	-
Genuine babbitt	3,410	662	2,000	294	73
Other tin babbitts	1,705	362	1,145	84	12
Solder (to 15 percent tin)	4,982	4,612	360	-	-
Solder (15 to 30 percent tin)	23,037	15,355	5,653	-	
Solder (over 30 percent tin)	16,426	9,648	6,348		-
Linotype metal	17,239	14,309	809	1 961	8
Other type metals	18,656	15,275	1,011	1,373	1
Miscellaneous lead-tin alloys	525	206	184	17	-
	[1] 328,157	279,672	18,964	[2] 21,543	94
Antimonial lead castings	1,339	1 259		80	-
Common babbitt bearings	8,677	6,421	1,041	1,215	
Tin content of chemical products	1,138		1,138		-

[1] This total includes 7,884 tons of primary metals.
[2] Includes 1,209 tons of antimony from ore.

Refined secondary pig lead totaling 74,959 short tons was produced at 131 plants representing 109 concerns classed as remelters, smelters, and refiners. Of this refined lead, 55,800 tons (74 percent) were produced at only 20 plants.

Production of secondary antimonial pig lead amounted to 226,353 short tons (gross weight), almost all recovered from old storage

batteries. Including lead babbitts, solders, type metals, and miscellaneous lead-base alloys, the total secondary lead and lead-base alloy products reported in 1941 amounted to 409,488 short tons, gross weight. In all, 189 plants were engaged in remelting, smelting, and refining lead and lead alloys, whereas 20 additional smelters and 406 manufacturing plants (mostly foundries) consumed lead and lead-alloy scrap in products other than secondary pig.

It is difficult to draw a distinction between secondary lead smelters and scrap-metal dealers, some of whom melt large quantities of scrap lead in simple pot installations. Measurement of the secondary white metals industry is complicated further by the practice of melting and smelting scrap alloys and drosses containing lead, tin, and antimony to produce so-called "percentage metals," which are pigged and analyzed for subsequent blending in alloys to be sold on specification. For example, solder sweated from lead or copper pipe joints might be thoroughly mixed in a pot, pigged, and analyzed to ascertain the lead and tin contents. The resultant pigs would then be marked and held until an order for solder was received, at which time the alloy would be remelted and the lead-tin proportion adjusted by the addition of either a high-tin alloy or perhaps some very low tin solder stock, until the ratio specified in the order was met. Lead-antimony and lead-tin-antimony scrap alloys are treated similarly, and the percentage metals are used in production of bearing metals, type metals, and antimonial lead.

Although some remelted lead-base and tin-base alloy pigs produced by small remelters are sold directly to manufacturers, others are sold to larger secondary smelters for consumption in specification metals. Thus, percentage metals are reported by the first melter as secondary products recovered from scrap, but the metal contents appear again in the production reports of large smelters. Process metals of this class were deleted from the 1941 statistics to avoid duplication.

Consumption of purchased lead scrap in the United States in 1941, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers [1] and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Soft lead	992	34,591	926	1,212	37,721
Hard lead	539	37,693	117	234	38,583
Cable lead		21,779		70	21,849
Battery-lead plates		257,638		6,552	264,190
Mixed common babbitt	109	6,574		9,077	15,760
Solder	36	9,536		144	9,716
Type metals		15,483	11	3,858	19,352
Dross	7,857	42,345		4,328	54,530
Lead oxide	643	4,650			5,293
Residues	328	6,956			7,284
	10,504	437,245	1,054	25,475	474,278

[1] The lead-base scrap listed as consumed by manufacturers and foundries in 1941 cannot be compared with earlier reports of lead-base scrap consumed by this group in 1940, owing to the recent transfer of 29 large plants (equipped with smelting facilities) from the manufacturer group to the remelter-smelter-refiner group. If the transfer had not been made, this table for 1941 would have shown a total of 343,824 tons consumed by remelters, smelters, and refiners and 130,454 tons of scrap consumed by manufacturers and foundries.

Of the 474,278 short tons of lead-base scrap consumed in 1941, only 11,558 tons (2 percent) were classed as new scrap, and 462,720 tons (98 percent) were old scrap returned for salvage after having served a useful purpose. As usual, battery-lead plates dominated the picture, comprising 56 percent of all lead-base scrap consumed during 1941 and exceeding the 1940 figure by almost 100,000 tons. Reclamation of cable lead dropped slightly, reflecting the tendency of utilities to make existing equipment serve a longer life. A 66-percent increase in consumption of drosses shows that dead stocks of low-grade by-products were brought into the market when a shortage of lead was threatened.

Illinois, with 24 secondary lead remelters and smelters worthy of mention, consumed 19 percent of all lead-base scrap, followed by 17 percent used in Pennsylvania (23 plants), 15 percent in New Jersey (16 plants), 10 percent in Indiana (6 plants), 8 percent in California (14 plants), and 8 percent in New York (27 plants); the remaining 23 percent of consumption was reported by 21 other States.

Consumers' stocks of purchased lead-base scrap in the United States at end of year, 1940–41, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1940 [1]	Dec 31, 1941
Unalloyed lead	4,119	2,733
Lead-base alloy	29,693	25,642
Drosses and residues	8,128	12,775
	41,940	41,150

[1] Revised figures.

Although no formal ceiling prices were applied to scrap lead during 1941, buyers were strongly urged to hold scrap prices to the usual relationship with primary lead quotations. Prices of both primary metal and scrap rose during the first 4 months of 1941 but leveled in April when the trade agreed to an informal ceiling of 5.85 cents a pound for primary pig in New York. Dealers' buying prices for heavy lead scrap in New York averaged 4.72 cents in January, climbed to an average of 5.18 cents in March, then leveled at 5.31 cents in April and stayed there through October. Heavy-scrap-lead prices averaged 5.36 in November and 5.37 in December; the rise was attributed to the expectation of official ceiling prices that would exceed the earlier informal levels. Scrap flow was greatly improved during these 2 months.

Dealers' quotations for battery-lead plates rose steadily from 2.75 cents a pound at the beginning of the year to 3.125 cents in March. The price rose to 3.25 cents in July and increased to 3.50 cents at the end of October in anticipation of a higher price for primary lead.

Battery-plate smelting charges ranged from $16 a ton (maintained through April) to $13 in September, then fluctuated between $13 and $14 until early in December, when the charge fell to $12. On December 18, 1941, quotations jumped to $20 a ton.

Effective January 15, 1942, maximum prices were set for lead-base scrap, battery-lead plates, batteries in boxes, and secondary lead, all in relation to base prices fixed for each of 146 city areas listed as main

shipping points in 34 States. Under the terms of this order, the maximum selling price of heavy-lead scrap in New York was fixed at 5.95 cents a pound, f. o. b. point of shipment. The price of primary pig lead was fixed on the same date at 6.50 cents a pound, delivered at New York.

Secondary lead produced from scrap was made subject to allocation on October 3, 1941. No priority control was exercised on lead scrap throughout 1941, but General Preference Order M-72, issued January 9, 1942, provided for direct allocation of lead scrap when necessary. Acceptance of deliveries of lead scrap at dealers' yards was made dependent on the ratio of shipments to inventories, and monthly reports of dealers' transactions were required.

Lead scrap was placed under export control on March 4, 1941, and effective March 24, 1941, a license was required for exporting materials containing over 15 percent lead.

SECONDARY MAGNESIUM

In 1941, 1,752 short tons of secondary magnesium were recovered. Value was set at $840,960, computed from an average price of 24 cents a pound. This quantity was recovered as 929 tons of magnesium in ingot, 738 tons of magnesium castings, 60 tons of magnesium added as a constituent in aluminum alloys, and 25 tons in reagents.

Secondary magnesium recovered in the United States, in 1941, in short tons

Magnesium alloys produced and recovered from scrap	1, 667
In aluminum alloys	60
In reagents	25
	1, 752
From new scrap	1, 737
From old scrap	15

Production of secondary magnesium [1] and magnesium-alloy products in the United States in 1941, gross weight, in short tons

Magnesium ingot	[2] 929
Magnesium castings	738

[1] This table does not include secondary magnesium recovered in other than magnesium-base products

[2] Approximately 470 short tons of this amount were incorporated in primary magnesium ingot, and the remainder was produced as secondary magnesium ingot

A total of 51 plants consumed 2,279 tons of magnesium-base scrap, which was almost entirely in the form of new scrap emanating from industrial operations. By far the largest tonnage of magnesium scrap consisted of borings and turnings, and this item represented 70 percent of the total; filings and grindings comprised 12 percent, sand castings 10 percent, and miscellaneous items 8 percent. The increased tempo of secondary magnesium consumption was revealed by the fact that 911 tons were consumed in the first 6 months of 1941 compared with 1,368 tons in the latter half of the year. Stocks of magnesium scrap were 204 tons at the start of 1941 and 239 tons at the close.

Sales of magnesium were under strict priority control as of March 24, 1941, and on November 14, 1941, General Preference Order M-2-b, issued by the Office of Production Management, required all

persons owning magnesium of any kind to report its existence by November 30. The new order provided for complete allocation of all magnesium supplies.

Stocks and consumption of magnesium scrap in the United States in 1941, gross weight, in short tons

	On hand—		Consumption during 1941
	Dec. 31, 1940	Dec. 31, 1941	
Cast scrap	20	15	266
Solid wrought scrap	52	22	103
Borings, grindings, drosses, etc	132	202	1,910
	204	239	2,279

To overcome the disadvantages of shipping bulky and inflammable magnesium scrap from scattered sections of the country to the few plants equipped for remelting, additional facilities were provided at strategic locations near the sources of magnesium scrap. On February 25, 1942, four smelting companies with a total of seven plants equipped for handling magnesium scrap were granted the right by the Government to purchase magnesium scrap for remelting into secondary magnesium ingot. Primary magnesium producers continued to remelt scrap from nearby areas.

SECONDARY NICKEL (NONFERROUS)

The 1941 survey of secondary nickel recovery was confined to that recovered from nonferrous scrap, and the incomplete report of nickel recovered in ferro-alloys in former years has been omitted from this report.

Secondary nickel recovered from nonferrous scrap in 1941 totaled 5,315 short tons valued at $3,720,500 compared with 4,152 tons valued at $2,906,400 in 1940. The value for both years was computed at 35 cents a pound, the spot-delivery price of electrolytic nickel, including duty.

Secondary nickel (nonferrous) recovered in the United States, 1940–41, in short tons

	1940	1941
As metal	3	248
In nickel alloys	841	1,267
In copper alloys	3,308	3,396
In chemical products		
Nickel sulfate	(1)	283
Nickel oxide	(1)	120
Nickel chloride, carbonate, cyanide, and nitrate	(1)	1
	4,152	5,315
From new scrap	2,184	3,181
From old scrap	1,968	2,134

1 Data not available.

Owing to the past reluctance of many nickel-scrap consumers to report their activities, figures for 1940 are believed to be incomplete, particularly with respect to nickel recovered as metal.

Production of secondary nickel and nonferrous nickel-alloy products in the United States in 1941, gross weight, in short tons

Refined nickel	79
Nickel anodes	169
Monel-metal bar and shot	289
Cupronickel bar and shot	2, 284
Nickel in chemical products	404

In 1941, 248 short tons of secondary nickel were recovered as metal, which appeared on the market as 79 tons of nickel bars and shot and 169 tons of recast nickel anodes. Production of secondary Monel-metal bar and shot amounted to 289 tons containing 178 tons of nickel, and secondary cupronickel totaled 2,284 short tons containing 1,089 tons of nickel. Of the total secondary nickel reported in nonferrous products, 64 percent was recovered in copper-base alloys represented principally by nickel silver. In addition to nickel as metal and in alloys, 404 tons were recovered in chemical products. Of this amount, 70 percent was in nickel sulfate, and most of the remainder was in nickel oxide, with a total of 1 ton contained in nickel chloride, carbonate, cyanide, and nitrate.

Consumption of purchased nickel scrap in the United States in 1941, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Pure nickel	140	42	105	147	434
Monel metal	383	1, 064	1, 790	74	3, 311
Nickel silver	766	1, 204	6, 894	266	9, 130
Miscellaneous nickel alloys	503	3, 019		2	3, 524
Nickel residues			122	432	554
	1, 792	5, 329	8, 911	921	16, 953

A total of 16,953 tons of nonferrous nickel scrap was consumed in 1941 compared with 12,404 tons in 1940. Nickel silver constituted slightly more than half of the scrap, and Monel metal and miscellaneous nickel alloys were each about one-fifth of the total.

Thirty-six remelters, smelters, and refiners used 42 percent of the total nickel scrap, and 109 manufacturers and foundries consumed the other 58 percent. Of the 9,832 tons of nickel scrap consumed by manufacturers and foundries, 7,025 tons were used by 17 brass mills, and only 2,807 tons were distributed among the remaining 92 plants.

Consumers' stocks of purchased nonferrous nickel scrap in the United States at end of year, 1940–41, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1940 [1]	Dec 31, 1941
Unalloyed nickel	93	60
Nonferrous nickel alloys	2, 217	3, 965
Nickel residues	472	485
	2, 782	4, 510

[1] Revised figures.

Dealers' buying prices for new nickel clips in New York in the first days of 1941 were between 37 and 40 cents a pound, and late in January they rose above 47 cents owing to heavy buying by Japan before export control went into effect. In February, prices dropped to the 30-cent level but gradually rose with increased industrial demand until a 55-cent price was quoted in April. The threat of ceiling prices by the Advisory Commission to the Council of National Defense made quotations nominal until June 2, 1941, when Price Schedule 8 fixed ceiling prices on scrap and secondary material. This action drove the price of clips down to the 24- to 25-cent level. During the latter half of 1941, the dealers' buying price for Monel clips in New York lay between 18 and 19 cents a pound.

Nickel, including scrap, was placed under export control on January 10, 1941, and after February 3, 1941, a license was required for exporting materials containing over 10 percent nickel.

SECONDARY TIN

Recovery of secondary tin rose to 42,033 short tons valued at $43,722,726 in 1941 compared with 33,222 short tons valued at $33,102,401 in 1940. The value was computed at 52.01 cents a pound in 1941 and at 49.82 cents a pound in 1940.

Tin recovered as metal increased to 5,900 tons, a 17-percent rise above the 5,056 tons recovered in 1940. Only seven plants, representing four companies, participated in the recovery of 5,089 short tons of metallic tin from tin-plate scrap in 1941, as the expansion program to accelerate recovery of tin from old cans was not yet under way. The 811 short tons of secondary tin recovered as metal at other plants represented the total reported by 40 remelters, smelters, and refiners and 3 manufacturers. Of this total, 60 tons of remelted tin were reclaimed from scrap tin by dealer-remelters and shipped to smelters for fire refining.

Secondary tin recovered in the United States, 1940–41, in short tons

	1940	1941
As metal		
At detinning plants	4,147	5,089
At other plants	909	811
	5,056	5,900
In copper alloys	13,950	16,298
In lead alloys	7,848	9,509
In tin alloys	5,671	9,188
In chemical compounds	697	1,138
	33,222	42,033
From new scrap	12,736	12,427
From old scrap	20,486	29,606

Almost one-fourth of the 1941 yield of secondary tin was recovered in the form of tin-base products, including metallic tin, tin babbitts, and tin chemicals. The next 40 percent emerged as the tin content of lead-base alloys, and the remaining 36 percent filled the greater part of the tin requirements in secondary brass and bronze products. Metallic tin and tin-base alloy products are listed in the production table in the Secondary Lead section of this chapter.

Block-tin scrap and foil, high-tin babbitts, and tin residues accounted for most of the 43-percent increase in tin-base scrap consumed in 1941. Tin scruff and dross resulting from tin-plate operations in 1941 almost duplicated the 4,936 tons used in 1940.

Dealers' buying prices for block-tin pipe in New York averaged 46.35 cents a pound in 1941 compared with 42.90 cents in 1940. The monthly average rose from 44.50 cents a pound in January to 47.50 cents in May and remained at this price until September, when the average dropped to 45.79 cents a pound. Quotations in each of the last 3 months averaged 45.50 cents.

Consumption of purchased tin scrap in the United States in 1941, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Block-tin pipe, scrap, and foil	52	1,287	49	104	1,492
Tin scruff and dross	4,970		1		4,971
No. 1 pewter		372		39	411
High-tin babbitt	47	4,107	1	159	4,314
Residues	368	3,348			3,716
Miscellaneous tin alloys	(1)	(1)			(1)
	5,437	9,114	51	302	14,904

1 Less than 1 ton.

Consumers' stocks of purchased tin-base scrap in the United States at end of year, 1940–41, gross weight, in short tons

Scrap item	On hand	
	Dec. 31, 1940 [1]	Dec. 31, 1941
Unalloyed tin	214	115
Tin-base alloys	482	624
Drosses and residues	704	1,639
	1,400	2,378

1 Revised figures.

Some small lots of tin scrap were reported sold during the summer months at prices higher than those for primary tin, but warnings from the Office of Price Administration, coupled with the ceiling price of 52 cents a pound for Grade A pig tin, established on August 15, 1941, tended to keep scrap prices fairly well in line.

The price of Grade B tin was fixed at 41.375 cents a pound on September 20, 1941, but no formal ceilings were set on tin-base scrap. There was no Federal control of scrap or secondary tin consumption or stocks before the Japanese attack on December 7, 1941.

Effective December 17, 1941, General Preference Order M-43 provided for allocation of all stocks of pig tin. This order was amended February 14, 1942, to freeze stocks of tin and tin alloys in the hands of manufacturing jewelers, and arrangements were made to purchase all such stocks for the Metals Reserve Co., with the National Lead Co. acting as agent.

On the last day of 1941, Conservation Order M–43–a ordered 50-percent curtailment in the use of tin in nondefense production, with the further provision that use of tin in 29 types of commercial articles should cease March 31, 1942.

General Preference Order M–72 provided for direct allocation of tin-base scrap to consumers when necessary in the interests of the war program. Acceptance of deliveries of tin scrap at dealers' yards was made dependent on the ratio of shipments to inventories in the preceding 60-day period, and monthly reports of dealers' transactions in tin scrap were required to be filed with the Bureau of Mines.

Early in January 1942, retail druggists were urged to set up collection bins for receiving used collapsible tubes of tin or tin-coated lead. Beginning April 7, 1942, consumers were required to turn in a used tube for each new one of toilet preparations purchased. The newly organized Tin Salvage Institute in Newark, N. J., was designated as the agent of the Metals Reserve Co. to reclaim the tin from collapsible tubes.

Detinning plants.—Recovery of tin from new tin-plate clippings was carried out during 1941 at seven plants: Metal & Thermit Corporation operated plants at Carteret, N. J., San Francisco, Calif., and East Chicago, Ind.; Vulcan Detinning Co., at Sewaren, N. J., and Neville Island, Pa.; Standard Metal Refining Co., at Baltimore, Md.; and Johnston & Jennings Co., at Cleveland, Ohio.

New tin-plate scrap treated totaled 341,075 long tons, exceeding the 1940 total of 268,269 long tons by 27 percent. Recovery of tin per ton of scrap treated stayed about the same as during 1940, owing to the fact that general reductions of thickness of the tin coating on steel did not take place until late in 1941.

Recovery of tin from old containers rose only slightly from 62 short tons in 1940 to 69 short tons in 1941.

No tin bichloride or tin crystals have been reported produced from tin-plate scrap since 1939.

Secondary tin recovered at detinning plants in the United States, 1940–41

	1940	1941
Scrap treated:		
Clean tin plate ... long tons	268,269	341,075
Old tin-coated containers ... do	4,963	5,963
	273,232	347,038
Tin recovered as metal:		
New tin-plate clippings ... short tons	4,085	5,020
Old tin-coated containers ... do	62	69
Tin content of tin tetrachloride, tin oxide, and sodium stannate produced ... short tons	697	1,067
	4,844	6,156
Weight of tin tetrachloride, tin oxide, and sodium stannate produced ... short tons	1,157	1,927
Average quantity of tin recovered per long ton of clean tin-plate scrap used ... pounds	35.65	35.69
Average delivered cost of clean tin-plate scrap ... per long ton	$16.59	$18.51

Several small independent plants were equipped for salvaging tin from old cans early in 1942, and six large plants were projected for Government financing. A program was mapped out for converting hot-dipping methods to electroplating of tin to conserve the supply,

and many large city areas arranged early in 1942 to collect empty tin cans for shipment to detinning plants. First reports from the detinning plants revealed that less than half of the old cans received had been properly prepared by washing and flattening.

Export regulations concerning tin-plate scrap adopted in 1940 were continued in force throughout 1941.

Imports for the first 9 months of 1941, mostly from Canada, totaled 15,989 long tons of tin-plate scrap valued at $200,626.

SECONDARY ZINC

The net weight of secondary zinc recovered totaled 283,967 short tons valued at $42,595,050 in 1941 compared with 222,013 short tons valued at $27,973,638 in 1940 (revised). The value was computed at 7.5 cents a pound in 1941 (the average selling price of all grades) and at 6.3 cents in 1940.

Secondary zinc recovered in the United States, 1940–41, in short tons

	1940	1941
As metal:		
By distillation:		
In slab zinc	[1] 48,917	59,306
Zinc dust	17,321	18,950
By remelting	2,704	11,400
	68,942	89,656
In alloys.		
Die-cast slab	([2])	2,571
Copper alloys	[3] 112,306	143,236
In chemical products:		
Zinc oxide	15,810	14,295
Zinc sulfate	1,958	2,840
Zinc chloride	9,132	13,613
Zinc carbonate and cyanide	([2])	348
Lithopone	13,865	17,408
	222,013	283,967
From new scrap	157,809	202,813
From old scrap	64,204	81,154

[1] Gross weight; includes 16,092 tons of zinc slab formerly classified as distilled from plant scrap.
[2] Data not available.
[3] Includes some plant scrap at brass mills.

Twenty-four zinc distillers contributed to a record production of 59,503 tons of secondary distilled slab containing 59,306 tons of zinc. This amount represents a 21-percent increase over the 1940 recovery of 48,917 (revised) short tons. Virtually 40 percent of the supply of secondary distilled slab was consumed by galvanizers, 30 percent by brass mills, 16 percent by die casters, 10 percent by rolling mills and extrusion plants, and the remainder by zinc oxide producers and other miscellaneous users.

The 18,950 tons of secondary zinc dust produced by nine distillers represented approximately 80 percent of the total zinc dust produced in the United States from all sources. More than half of this dust was consumed by the producers of sodium hydrosulfite.

The 2,704-ton figure for remelted zinc listed for 1940 was unusually low, because a large amount of the zinc in scrap used to produce spelter formerly was listed as having been recovered in copper alloys, and spelter produced by dealers was not reported. The 11,400 tons of remelted zinc reported in 1941 was recovered in 10,389 tons of remelt

spelter, 527 tons of galvanizing stock, 497 tons of zinc sheet, 78 tons of zinc powder, and 70 tons of zinc anodes. In addition to the 10,389 tons of remelt spelter listed, 430 tons of remelt spelter were consumed by zinc refiners, and this recovery is included in the weight of redistilled slab produced. Bureau of Mines surveys revealed that 1,967 tons of zinc were recovered in die-cast slab during the first 6 months of 1941, whereas only 604 tons were recovered in the second half.

Zinc is the principal alloying constituent of copper-base alloys, and 143,236 tons of secondary zinc were recovered in secondary brass and bronze. This quantity includes both the zinc originally contained and recovered in brass scrap and the zinc in zinc-base scrap added to secondary brass in the melting furnace.

Production of secondary zinc and zinc alloy products in the United States in 1941, gross weight, in short tons

Redistilled zinc slab	59, 503
Zinc dust	18, 950
Remelt spelter	10, 389
Remelt die-cast slab	2, 735
Galvanizing stock	527
Zinc sheet	497
Zinc powder	78
Zinc anodes	70
Zinc in chemical products	48, 504

Thirty-seven chemical manufacturers recovered 48,504 tons of secondary zinc in chemicals, a 19-percent increase over the 1940 recovery of 40,765 tons. High industrial activity, supplemented by an insufficient supply of titanium pigments, effected a sharp increase in the demand for lithopone at the end of 1941. The production of zinc oxide from zinc scrap and slab zinc declined, but the use of ore for oxide to supply the growing market increased sharply.

A major part of the zinc scrap treated in 1941 consisted of galvanizers' skimmings and dross; and zinc recovery from this source, added to increased recovery of zinc in brass cartridge scrap, explains the recovery of 71 percent of all secondary zinc from new scrap compared with 29 percent from old.

Consumption of purchased zinc scrap in the United States in 1941, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Clippings	3, 978		1, 537		5, 515
Sheet	299	6, 562	265	456	7, 582
Castings	471	1, 443	23	124	2, 061
Skimmings and ashes	57, 186		27, 861	18	85, 065
Dross	56, 620		37		56, 657
Die castings	305	12, 701	114	900	14, 020
Flue dust and residues	8, 819	16, 024	14, 233	7, 117	46, 193
	127, 678	36, 730	44, 070	8, 615	217, 093

Consumption and stocks of zinc scrap in the United States in 1940, gross weight, in short tons [1]

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Clippings	2,877	161	1,153	223	4,030
Sheet	12,009	804	73	57	12,082
Castings	822	355	18	16	840
Skimmings and ashes	62,552	19,079	7,463	4,320	70,015
Dross	46,457	5,311	5,201	6	51,658
Die castings	17,087	1,358	169	13	17,256
Flue dust and residues	7,833	11,542	18,853	3,701	26,686
	149,637	38,610	32,930	8,336	182,567

[1] Revised figures.

Zinc-base scrap and residues consumed in 1941 totaled 217,093 tons, composed of 39 percent skimmings and ashes, 26 percent dross, 21 percent flue dust and residues, 6 percent die castings, 4 percent sheet, 3 percent clippings, and 1 percent zinc castings.

Of the total zinc scrap used in 1941, Pennsylvania consumed 37 percent, Illinois 17 percent, New Jersey 7 percent, Delaware 6 percent, Oklahoma, West Virginia, Indiana, and Ohio each 5 percent, and all other States 13 percent.

Zinc scrap was used in the following proportion: 76 percent by 130 remelters, smelters, and refiners; 23 percent by 22 chemical plants making chemicals exclusively; and 1 percent by 239 manufacturers and foundries. Of the total secondary zinc recovered in the production of zinc chemicals, 39 percent was reported by concerns that could not be separately classified as chemical works, owing to their greater activity as smelters and refiners. One of the largest reservoirs of zinc was copper-base alloy scrap, from which 30,236 tons of secondary zinc were recovered from new scrap and 47,873 tons from old scrap. For the most part, the scrap containing this zinc was used to make secondary copper alloys such as brass and bronze, but some low-grade brass scrap was put through a copper-recovery process in which most of the zinc content was converted to flue dust.

Of the total zinc scrap consumed, 79 percent represented new scrap. Remelters, smelters, and refiners used 78 percent new scrap and 22 percent old, and chemical works and other manufacturers (and foundries) used 84 percent new scrap and only 16 percent old

Consumers' stocks of purchased zinc-base scrap in the United States at end of year, 1940–41, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1940 [1]	Dec. 31, 1941
Metallic zinc scrap	3,126	1,378
Dross	5,317	5,634
Skimmings and residues	38,503	32,433
	46,946	39,445

[1] Revised figures.

Dealers' buying prices for new zinc clips in New York averaged 6.59 cents a pound in 1941 compared with 4.81 cents in 1940, a 37-percent rise. Prices experienced an inflationary period at the beginning of the year when zinc clips averaged 6.70 cents in January, 7.92 cents in February, and 9.09 cents in March. Pressure on prices encouraged speculation to the point that zinc scrap was withheld from the market, and the prices of zinc scrap materials and secondary slab rose to exceed that of primary slab. As a measure to prevent speculation and to maintain price stability, maximum prices on sales of secondary and scrap zinc were established on March 31, 1941. Secondary slab of Prime Western grade was fixed at 7.25 cents a pound f. o. b. East St. Louis, and High-Grade zinc was set at 8.25 cents.

The maximum dealers' selling price for new zinc clips was set at 6.75 cents delivered at buyers' plants. This ceiling forced the average dealers' buying prices down to 5.87 cents in April, where it remained through September. In October, the Office of Price Administration raised the price of Prime Western secondary zinc to 8.25 cents, and the selling price of zinc clips was adjusted to 7.25 cents. This accounted for the 6.87-cent average dealers' buying price maintained through November and December. A formal ceiling order on January 29, 1942, forced adherence to primary zinc prices previously held down by informal agreement.

Throughout 1941 the zinc industry was under close surveillance of the Government. On April 1, a monthly production pool was established from which the Office of Production Management allocated zinc to meet emergency demands. The amount reserved for this pool each month increased from 3,000 tons in April to over 24,000 tons in November.

On July 1, 1941, the zinc industry was put under full priority control by General Preference Order M-11. This order continued the zinc pool so as to include production of all grades of distilled zinc, both primary and secondary, as well as zinc oxide and dust. The zinc that remained after the required amount had been set aside in the pool was to be shipped in such manner that each customer should receive a percentage of the producers' commitments to him for the month, including both defense and nondefense orders, equal to the percentage received by every other customer. These restrictions also applied to interplant transfers and toll agreements and included galvanizers who redistilled zinc from dross or skimmings.

Imports of metallic zinc scrap into the United States for the first 9 months of 1941 totaled 59 tons compared with 164 tons for the whole year 1940, and imports of zinc dross and skimmings were 353 tons for 9 months of 1941 compared with 356 tons in 1940. There were 519 tons of skimmings imported through September 1941 for smelting, refining, and reexporting. Zinc scrap was placed under export control on January 10, 1941, and effective February 3, 1941, a license was required for exporting materials containing over 15 percent zinc.

IRON AND STEEL SCRAP [1]

By Harold E. Carmony

SUMMARY OUTLINE

GENERAL SUMMARY

Under the impetus of greatly increased activity in war industries, steel-ingot production in 1941 surged to unprecedented heights, creating the greatest demand for iron and steel scrap ever known. The production of steel ingots in 1941 increased 24 percent over that in 1940. Reflecting this rise in steel-ingot production, the use of ferrous scrap increased 33 percent over that consumed in the previous record year—1940. This greater increase in the use of scrap as compared with the rise in the steel-ingot production was necessitated by the relatively smaller increase in pig-iron production, which rose 20 percent over 1940. During the first 6 months of 1941, scrap consumption was fairly stable, but with the accelerated rate of war-material manufacture, demand improved as steel production soared to record proportions in the closing months of the year. The consumption of scrap probably reached an all-time peak in October 1941. Despite the large increase in demand, prices increased only slightly as a result of price-control activities of the Federal war agencies. Stocks of iron and steel scrap consistently declined throughout the year. During November and December, many consumers were obliged to increase the amount of pig iron used because of the curtailment of available supplies of scrap caused by the continued large demand.

The total consumption of ferrous scrap and pig iron in 1941 increased 27 percent over that in 1940. Of the 115,401,728 net tons used, 93,042,313 tons were charged to steel-making furnaces and 22,359,415 tons to iron furnaces. In making the average ton of steel in 1941 more scrap and less pig iron were used than in 1940; the relative consumption of home scrap increased considerably in 1941 over 1940, and that of purchased scrap increased slightly. In iron furnaces the relative use of total scrap also increased, and that of pig iron decreased. This increase in the relative use of scrap resulted from larger consumption of home scrap in 1941 compared with 1940. The proportion of purchased scrap used increased only slightly.

Statistics on exports of ferrous scrap from the United States in 1941 are not available for publication, except the total amount exported during the first 9 months of the year. However, from the data pro-

[1] Minerals Yearbook, 1939, p. 513, defines the various scrap terms used in this report.

curable, it is evident that exports were considerably lower in 1941 than in 1940 and previous years. The exportation of scrap was limited, by restrictions imposed by the Federal Government in October 1940, to countries of the Western Hemisphere and the United Kingdom. Two joint resolutions that would directly or indirectly impose restrictions on the exportation of scrap from all the Territories, dependencies, and possessions of the United States were introduced during the first session of the Seventy-seventh Congress. After extensive testimony, one of these, S. J. Res. 76, was approved on May 28, 1941, and became Public, No. 75, 77th Congress. Also introduced was a bill designed to suspend the effectiveness, during the national emergency, of tariff duties on scrap iron, scrap steel, and nonferrous-metal scrap, but the Congress adjourned without acting on the proposed legislation.

Since the outbreak of war in 1939 there has been no cartel activity by foreign consumers for the purpose of securing scrap for exportation from the United States. Consequently, all countries that purchased scrap in 1941 acted independently.

Prices for scrap fluctuated within narrower limits in 1941 than in 1940. This smaller fluctuation did not result from actual supply-demand relationships, but from the attempts of the scrap industry to conform to the request of the Government to voluntarily halt the advancing trend in scrap-steel prices. During the first quarter of 1941, the price stabilization agency of the Government continued the conferences, initiated in the latter months of 1940 between steel-mill and scrap-trade representatives, designed to achieve voluntary reduction in scrap prices. However, the effect of these conferences was only partly successful. According to Iron Age, the quotation for No. 1 Heavy-melting steel scrap at Pittsburgh declined from a high of $23.75 a gross ton the first week in January 1941 to a low of $20.75 the second week in February but then increased slightly to $21.00. On April 3, 1941, the Government issued Price Schedule 4, establishing maximum prices for iron and steel scrap. Under this schedule, the price of No. 1 Heavy-melting steel scrap was stabilized at $20.00 at Pittsburgh with other grades and districts based thereon. The resultant average price for 1941 was $20.34 compared with $19.26 in 1940 and was the highest since 1923, when the average was only a few cents higher. Scrap prices received strong support from both the domestic and foreign markets—support created by increased domestic demand and the need for scrap by the democratic nations. The price of basic pig iron, established at $23.50 per gross ton at Valley furnaces in December 1940, prevailed throughout 1941.

The continued high operating rates in steel production during the earlier part of the year precipitated such an abnormal demand for scrap that dealers and brokers found it difficult to cover commitments. This occasioned considerable alarm as to the depleted condition of domestic stocks of iron and steel scrap. Consequently, the Priorities Division, Office of Production Management, issued General Metals Order 1. Designed to conserve existing supplies, this order restricted accumulation of inventories and eliminated excessive inventories by curtailing deliveries. The quarterly surveys inaugurated by the Bureau of Mines in September 1939 to ascertain the stock situation were continued through the first 6 months of 1941, at which time they were expanded and conducted upon a monthly basis. Since the scrap-supply situation, as shown by these surveys, did not improve satisfactorily the Priorities Division in October issued General Preference

Order M–24, devised to conserve the supply and direct the distribution of iron and steel scrap, and placed scrap under full priority control, allocating it in a manner similar to pig iron. At the same time the Bureau of Mines expanded its monthly iron and steel scrap surveys, furnishing the results to the Office of Production Management and other defense agencies for their confidential use. The survey of suppliers', producers', and consumers' stocks at the end of 1941[2] indicated inventories approximating 4,994,000 net tons, which was equivalent to a 4-week supply at the December rate of consumption. This showed a declining trend in iron and steel scrap stocks, as surveys conducted earlier in the year indicated that inventories were equivalent to a 5- to 6-week supply at the rate of consumption at that time. Consumers' stocks of scrap decreased from 5,471,554 tons at the beginning of 1941 to 3,726,030 tons at the close.

Salient statistics of ferrous scrap and pig iron in the United States, 1940–41

	1940	1941	Change in 1941 (percent)
Stocks, December 31:			
Ferrous scrap and pig iron at consumers' plants:	*Net tons*	*Net tons*	
Home scrap	1,783,920	1,166,551	−35
Purchased scrap	3,687,634	2,559,479	−31
Pig iron	3,242,324	1,585,199	−51
	8,713,878	5,311,229	−39
Ferrous scrap at suppliers' yards and producers' plants:			
Prepared scrap	1,418,266	675,952	−52
Unprepared scrap	724,087	515,417	−29
Scrap in transit to yards or for export and at docks	48,958	(1)	(1)
	2,191,311	1,191,369	−46
Consumption.			
Ferrous scrap and pig iron charged to—			
Steel furnaces:[2]			
Home scrap	19,680,106	26,433,206	+34
Purchased scrap	14,080,677	18,061,681	+28
Pig iron	40,172,734	48,547,426	+21
	73,933,517	93,042,313	+26
Iron furnaces.[3]			
Home scrap	5,367,617	7,471,474	+39
Purchased scrap	5,401,271	7,249,895	+34
Pig iron	6,013,094	7,638,046	+27
	16,781,982	22,359,415	+33
All furnaces			
Home scrap	25,047,723	33,904,680	+35
Purchased scrap	19,481,948	25,311,576	+30
Pig iron	46,185,828	56,185,472	+22
	90,715,499	115,401,728	+27
Ferrous scrap (total)	44,529,671	59,216,256	+33
Exports.			
Iron and steel	3,126,389	[4] 685,464	
Tin plate, waste-waste, circles, strips, cobbles, etc.	15,923	[4] 9,989	
Average prices per gross ton:			
Scrap.			
No 1 Heavy-melting, Pittsburgh[5]	$19.26	$20 34	+6
No. 1 Cast cupola[5]	19.85	22.25	+12
For export	16 87	18 56	+10
Pig iron, f. o. b. Valley furnaces[5]			
Basic	22.52	23.50	+4
No. 2 Foundry	23.03	24.00	+4

[1] Data not obtained in 1941 canvass.
[2] Includes open-hearth, bessemer, and electric furnaces.
[3] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.
[4] Figures cover January to September, inclusive.
[5] Iron Age.

[2] Bureau of Mines, Iron and Steel Scrap Monthly Stock Reports: No. 16, May 18, 1942, 7 pp.

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Figure 1 shows the consumption of purchased scrap and the output of pig iron and steel ingots and castings from 1905 to 1941, inclusive.

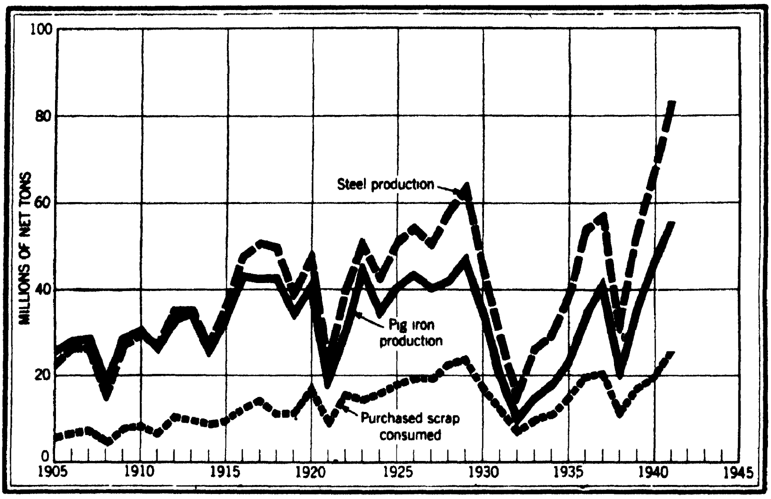

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–41. Figures on consumption of purchased scrap for 1905–32 are from *State of Minnesota* vs. *Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimates by authors; and those for 1935–41 are based upon Bureau of Mines reports Figures on output of pig iron and steel are as given by the American Iron and Steel Institute.

PRICES[3]

Scrap prices in 1941 were moderate, especially in view of the fact that steel-ingot production with the exception of 2 weeks consistently exceeded 95 percent of rated capacity. Market quotations for No. 1 Heavy-melting steel and No. 1 Cast cupola scrap, which had averaged $22.80 and $22.65 a gross ton (Pittsburgh), respectively, in December 1940, eased off; No. 1 Heavy-melting steel dropped to $20.75 in the second week of February, and No. 1 Cast cupola scrap dropped to $21.75 in the second week of January. This moderate price schedule was due not to market conditions but rather to pressure applied by the Price Stabilization Division of the Advisory Commission to the Council of National Defense for voluntary cooperation by the scrap industry to stabilize scrap prices. However, competition for supplies was too keen to permit a voluntary stabilization program to operate successfully, and prices soon resumed an upward trend. No. 1 Heavy-melting steel reached $21.00 the third week in February and No. 1 Cast cupola scrap rose to $23.25 the third week in March. Prices remained at these levels until the first week in April, when the Price Stabilization Division, later known as the Office of Price Administration, issued Price Schedule 4 establishing maximum prices for iron and steel scrap. Under this schedule No. 1 Heavy-melting steel, at Pittsburgh, was set at $20.00 per gross ton and was maintained throughout the remainder of the year at this point. The established prices for other grades of steel scrap were based upon the price of No. 1 Heavy-melting steel, and price differentials for other districts were standardized, using the Pittsburgh prices as a basis. The price for No. 1 Cupola cast was established at no more than $2.00

[3] Pittsburgh price quotations from Iron Age.

per gross ton under the price of No. 2 Foundry pig iron, delivered at the same point. On May 7, 1941, the price of No. 1 Cupola cast was changed to $22.00, Pittsburgh, with differentials for other districts based upon this price.

There were several minor revisions of Price Schedule 4 throughout the year, which included changes in export prices, addition or deletion of basing points, modification of shipping-point prices, and an increase in prices for scrap in remote States. On December 23, 1941, a major revision in the price structure was introduced with a view toward increasing the collection of all kinds of scrap and directing the flow of particular types to plants of consumers needing special scrap items. This revision classified the various types and grades of scrap according to use and established maximum prices for each type of consumer; however, the basic price remained unchanged. In this new amendment the price of No. 1 Cupola cast was changed from the basing-point system to an f. o. b. shipping-point price under which the United States was divided into three groups containing certain specified States, the price varying according to the location of the group.

In contrast to the fluctuations in scrap prices, the price of basic pig iron, established at $23.50 a gross ton at Valley furnaces late in December 1940, remained unchanged throughout 1941.

On May 29, 1941, the Office of Price Administration and Civilian Supply, acting under an Executive order, issued Price Schedule 8 governing scrap and secondary materials containing nickel. This schedule included stainless steel and nickel-steel scrap.

Export scrap prices for the first 9 months of 1941, as indicated by the declared value of iron and steel-scrap exports, averaged $18.56 a gross ton and were much higher than the 1940 average of $16.87. The 1941 average price—$18.56—was slightly less than the recent highest yearly average—$18.91—which was attained in 1937. The price structure during the first 4 months of 1941 was relatively strong due to the difficulty of obtaining material for loading, but after this period the prices were fairly well established under Price Schedule 4. The average value of exports in April—$19.62—represented the high monthly average for the 9 months for which statistics are available. After April export values declined, reaching the low point of the first three quarters of the year in September when the average was $17.38 a ton.

LEGISLATION

Since H. R. 9850, Seventy-sixth Congress, authorizing licensing of exports was approved and became Public, No. 703, no new bills advocating further restrictions on the exportation of iron and steel scrap have been introduced. However, two joint resolutions extending the application of Section 6 of Public, No. 703, Seventy-sixth Congress, to all Territories, dependencies, and possessions of the United States were introduced during the first session of the Seventy-seventh Congress. After much debate in both the Senate and the House of Representatives, Representative May's resolution (H. J. Res. 183, 77th Cong.) was tabled, and Senator Reynolds' resolution (S. J. Res. 76, 77th Cong.) was approved and became Public, No. 75, on May 28, 1941. Section 6 of Public, No. 703, Seventy-sixth Congress, and Public, No. 75, Seventy-seventh Congress, provide for the licensing, under proclamation by the President, of exports of materials deemed

necessary in the interest of national defense. Acting under these laws, the President on May 28, 1941, proclaimed that all articles and materials described in previous proclamations issued pursuant to section 6 shall not be exported from the Territories, dependencies, and possessions of the United States, including the Philippine Islands, the Canal Zone, and the District of Columbia, except when authorized in each case by license. One bill[4] calling for the suspension of tariff duties on scrap metal was introduced during this session, but Congress adjourned without acting on the bill, deferring further consideration to the 1942 session of the Seventy-seventh Congress.

On May 1, 1941, the Priorities Division, Office of Production Management, acting under an Executive order signed by the President, issued General Metals Order 1 to restrict inventory accumulations of certain specified materials. This order, designed to conserve existing supplies of certain specified materials, including iron and steel scrap, restricted inventory accumulation and eliminated excessive inventories by curtailing deliveries. Then, on October 11, 1941, the Priorities Division issued General Preference Order M-24 to conserve the supply and direct the distribution of iron and steel scrap. Under this preference order, iron and steel scrap was placed under full priority control, and allocation of scrap was inaugurated in a manner similar to the allocation of pig iron.

STOCKS

Visible supplies of iron and steel scrap and pig iron in the United States were determined by the regular annual canvass of consumers of these materials and the monthly canvass of suppliers and producers. The monthly canvass had been expanded to include as suppliers all dealers and automobile wreckers and as producers all railroads and manufacturing plants that produced 50 tons of scrap in a month. The final results of the annual survey indicate that consumers', suppliers', and producers' stocks of iron and steel scrap totaled 4,917,399 net tons on December 31, 1941. This total of 4,917,399 tons represents a 36-percent decrease from the 7,662,865 tons on hand December 31, 1940, even with the addition of a large number of concerns that were not canvassed in the previous year.

Consumers' stocks.—Consumers' stocks of home and purchased scrap were considerably less at the end of 1941 than at the beginning of the year. The supply of 1,166,551 net tons of home scrap on hand December 31, 1941, represented a 35-percent decrease from the 1,783,920 tons on hand at the beginning of the year, and the supply of 2,559,479 tons of purchased scrap on hand at the end of 1941 was a 31-percent decrease from the 3,687,634 tons on hand December 31, 1940. Thus, consumers' stocks of scrap totaling 3,726,030 tons at the year end were 32 percent less than the 5,471,554 tons on hand at the beginning of the year.

Likewise, consumers' stocks of pig iron totaling 1,585,199 tons at the end of the year had decreased 51 percent from the 3,242,324 tons on hand at the beginning of the year.

Suppliers' and producers' stocks.—In appraising stocks insofar as suppliers and producers are concerned, it should be noted that the coverage of the canvass is not known precisely. However, the data

[4] H. R. 5985. To suspend the effectiveness, during the existing national emergency, of tariff duties on scrap iron, scrap steel, and nonferrous-metal scrap.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on December 31, 1940, and December 31, 1941, by States and districts, in net tons

State and district	December 31, 1940				December 31, 1941			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	8,706	36,996	45,702	37,777	9,304	27,616	36,920	26,444
Maine	132	2,037	2,169	4,911	81	2,256	2,337	3,928
Massachusetts	14,979	52,504	67,483	146,512	14,988	62,202	77,190	77,773
New Hampshire	313	1,792	2,105	1,082	215	2,790	3,005	1,765
Rhode Island	2,285	6,725	9,010	13,560	1,284	7,706	8,990	12,070
Vermont	161	3,939	4,100	1,354	395	4,965	5,360	3,722
Total New England	26,576	103,993	130,569	205,196	26,267	107,535	133,802	125,702
Delaware New Jersey	17,480	100,860	118,340	109,604	22,229	98,754	120,983	44,536
New York	126,159	267,085	393,244	292,844	55,023	130,981	186,004	103,311
Pennsylvania	483,899	646,922	1,130,821	585,514	397,072	490,309	887,381	334,786
Total Middle Atlantic	627,538	1,014,867	1,642,405	987,962	474,324	720,044	1,194,368	482,633
Alabama	55,988	60,753	116,741	119,388	33,479	38,590	72,069	40,111
District of Columbia Kentucky Maryland	97,213	77,985	175,198	95,741	31,477	41,398	72,875	29,377
Florida Georgia	902	21,789	22,691	18,137	833	29,743	30,576	5,506
Mississippi	162	58	220	156	100	275	375	135
North Carolina	613	4,232	4,845	1,236	159	5,177	5,336	1,212
South Carolina	64	219	283	494	844	2,143	2,987	667
Tennessee Virginia	11,806	42,923	54,729	43,944	15,422	32,159	47,581	19,045
West Virginia	4,677	138,320	142,997	38,963	6,176	33,784	39,960	26,250
Total Southeastern	171,425	346,279	517,704	318,059	88,490	183,269	271,759	122,305
Arkansas Louisiana Oklahoma	1,676	12,580	14,256	805	434	18,573	19,007	790
Texas	4,179	16,199	20,378	573	6,806	27,602	34,408	1,385
Total Southwestern	5,855	28,779	34,634	1,378	7,240	46,175	53,415	2,175
Illinois	172,885	472,129	645,014	390,589	111,846	317,538	429,384	147,356
Indiana	255,897	289,139	545,036	210,365	103,529	240,384	343,913	99,170
Iowa	872	25,174	26,046	18,785	1,508	30,765	32,273	10,668
Kansas Nebraska	1,829	13,421	15,250	1,217	863	13,739	14,602	780
Michigan Wisconsin	93,050	256,213	349,263	378,790	89,521	210,891	300,412	237,570
Minnesota	10,469	28,829	39,298	16,022	4,401	51,767	56,168	5,713
Missouri	3,830	77,956	81,786	13,249	7,709	69,168	76,877	11,706
North Dakota South Dakota	905	163	1,068	44	2,092	274	2,366	51
Ohio	381,846	708,397	1,090,243	5 3,352	215,993	273,206	489,199	250,580
Total North Central	921,583	1,871,421	2,793,004	1,602,413	537,462	1,207,732	1,745,194	763,594
Arizona Nevada New Mexico	3,928	6,413	10,341	77	2,350	7,571	9,921	95
Colorado Utah	12,837	109,490	122,327	101,823	8,093	71,475	79,568	9,130
Idaho	316	1,004	1,320	40	130	3,534	3,664	52
Wyoming	5		5	2	5	1	6	2
Montana	23	5,105	5,128	257	1,279	15,235	16,514	252
Total Rocky Mountain	17,100	122,012	139,121	102,199	11,857	97,816	109,673	9,531
Alaska Oregon Washington	1,105	49,820	50,925	3,250	5,573	51,358	56,931	2,740
California	12,729	150,463	163,192	21,867	15,338	145,550	160,888	76,519
Total Pacific Coast	13,834	200,283	214,117	25,117	20,911	196,908	217,819	79,259
Total United States	1,783,920	3,687,634	5,471,554	3,242,324	1,166,551	2,559,479	3,726,030	1,585,199

Suppliers' stocks of iron and steel scrap on hand December 31, 1940, and December 31, 1941, by States and districts, in net tons

State and district	December 31, 1940			December 31, 1941		
	Prepared	Unprepared	Total	Prepared	Unprepared	Total
Connecticut	19,568	10,387	29,955	11,615	3,794	15,409
Maine	7,718	3,020	10,738	5,094	1,212	6,306
Massachusetts	30,897	23,394	54,291	13,940	17,959	31,899
New Hampshire	2,864	2,417	5,281	978	766	1,744
Rhode Island	5,903	3,141	9,044	1,437	707	2,144
Vermont	2,348	2,335	4,683	2,465	1,793	4,258
Total New England	69,298	44,694	113,992	35,529	26,231	61,760
Delaware	2,041	1,094	3,135	939	497	1,436
New Jersey	46,492	30,524	77,016	22,290	16,416	38,706
New York	107,723	63,841	171,564	54,783	37,179	91,962
Pennsylvania	112,154	88,274	200,428	42,355	57,876	100,231
Total Middle Atlantic	268,410	183,733	452,143	120,367	111,968	232,335
Alabama	13,077	5,190	18,267	5,932	7,226	13,158
District of Columbia	1,597	2,228	3,825	482	1,392	1,874
Florida	17,575	4,532	22,107	6,303	3,625	9,928
Georgia	14,580	4,404	18,984	9,681	4,253	13,934
Kentucky	28,192	6,635	34,827	8,533	6,255	14,788
Maryland	24,962	22,482	47,444	3,662	13,026	16,688
Mississippi	4,392	1,492	5,884	2,166	2,077	4,243
North Carolina	18,125	5,419	23,544	7,108	2,727	9,835
South Carolina	12,801	5,251	18,052	6,698	1,169	7,867
Tennessee	12,669	8,334	21,003	13,769	7,543	21,312
Virginia	46,784	7,135	53,919	15,970	8,505	24,475
West Virginia	8,238	5,292	13,530	6,748	6,459	13,207
Total Southeastern	202,992	78,394	281,386	87,052	64,257	151,309
Arkansas	9,134	3,695	12,829	2,381	2,223	4,604
Louisiana	20,739	9,666	30,405	10,139	7,954	18,093
Oklahoma	7,637	6,395	14,032	5,376	4,383	9,759
Texas	122,366	21,141	143,507	25,402	22,478	47,880
Total Southwestern	159,876	40,897	200,773	43,298	37,038	80,336
Illinois	141,387	124,616	266,003	77,894	48,768	126,662
Indiana	55,920	16,885	72,805	21,185	21,763	42,948
Iowa	22,231	9,725	31,956	8,644	15,095	23,739
Kansas	11,682	6,420	18,102	7,748	7,699	15,447
Michigan	65,058	28,391	93,449	29,783	24,335	54,118
Minnesota	112,563	27,837	140,400	67,650	23,502	91,152
Missouri	26,677	29,927	56,604	12,024	17,720	29,744
Nebraska	10,462	5,235	15,697	4,161	4,922	9,083
North Dakota	1,893	1,430	3,323	784	654	1,438
Ohio	101,752	86,092	187,844	64,219	47,804	112,023
South Dakota	577	2,230	2,807	505	1,216	1,721
Wisconsin	27,109	22,053	49,162	18,121	20,557	38,678
Total North Central	577,311	360,841	938,152	312,718	234,035	546,753
Arizona	459	1,056	1,515	140	515	655
Colorado	15,969	8,723	24,692	5,872	3,650	9,522
Idaho	129	1,135	1,264	2,258	644	2,902
Montana	3,271	1,403	4,674	390	2,979	3,369
Nevada	185	610	795	334	207	541
New Mexico	560	73	633	584	17	601
Utah	4,355	4,020	8,375	511	4,327	4,838
Wyoming	24,730	1,809	26,539	5,443	586	6,029
Total Rocky Mountain	49,658	18,829	68,487	15,532	12,925	28,457
California	58,971	27,762	86,733	43,130	19,602	62,732
Oregon	22,290	5,728	28,018	6,904	2,667	9,571
Washington	9,460	12,167	21,627	11,422	6,694	18,116
Total Pacific Coast	90,721	45,657	136,378	61,456	28,963	90,419
Total United States	1,418,266	773,045	2,191,311	675,952	515,417	1,191,369

assembled include virtually complete returns from the larger suppliers and producers, as well as a representative number of returns from others, and the figures shown probably reveal a very substantial part of the total visible supplies of iron and steel scrap in suppliers' and producers' hands.

Stocks held by dealers, automobile wreckers, railroads, and manufacturers declined from 2,191,311 net tons on December 31, 1940, to 1,191,369 tons on December 31, 1941, or 46 percent. Stocks in the hands of the larger suppliers were 76 percent lower at the end of 1941 than at the end of 1940, and railroad inventories declined 43 percent during the same period.

CONSUMPTION

In the canvass of consumers of ferrous scrap and pig iron, data are assembled only on that portion of scrap used in remelting processes. To simplify the annual canvass, no details are sought regarding the ordinary trade classifications of scrap consumed, and no attempt is made to obtain data on its value or cost at consumers' plants. Statistics are compiled to show the consumption of scrap and pig iron by districts and States and by types of furnace. To avoid disclosing details concerning individual plants reporting it is necessary in some instances to combine figures for some States. All such combinations are made with a view to revealing details of consumption by types of furnace rather than by geographic subdivisions.

The importance of scrap in the conservation of resources is illustrated by the relative quantities of scrap and ore used in the domestic iron and steel industry. The total scrap consumed in 1941 was equivalent to 123 percent of the iron content of all domestic and foreign iron and manganiferous ores used in blast furnaces, and purchased scrap alone equaled 53 percent of the iron content of the ores; in 1940 the comparable percentages were 111 and 48.

Scrap constitutes by far the greater part of the ferrous raw materials used in iron and steel plants in the Southwestern, Pacific Coast, and New England districts. These regions, however, used less than 5 percent of the total scrap consumed in 1941. In the New England district proportionately less scrap was used in 1941 than in 1940; whereas in the remaining districts (Middle Atlantic, Southeastern, Southwestern, North Central, Rocky Mountain, and Pacific Coast) proportionately more scrap was used.

Open-hearth steel furnaces use by far the largest quantities of ferrous scrap and pig iron. They consumed 67 percent of the total scrap in 1941 (70 percent in 1940), 71 percent of the home scrap (73 percent in 1940), 63 percent of the purchased scrap (65 percent in 1940), and 75 percent of the pig iron (79 percent in 1940).

In cupola furnaces, the second-largest consumers of scrap, the relative consumption of home and purchased scrap did not change from 1940, when the percentages were 15 and 22, respectively; however, their consumption of pig iron increased to 10 percent in 1941 from 9 percent in 1940.

Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1940–41, by districts

District	1940					1941				
	Total used (net tons)	Percent of total used				Total used (net tons)	Percent of total used			
		Scrap			Pig iron		Scrap			Pig iron
		Home	Purchased	Total			Home	Purchased	Total	
New England	999,597	28.4	41.4	69.8	30.2	1,532,883	31.9	37.0	68.9	31.1
Middle Atlantic	31,205,021	26.2	18.0	44.2	55.8	40,056,774	28.6	19.5	48.1	51.9
Southeastern	12,528,675	25.1	19.8	44.9	55.1	14,286,365	26.3	19.8	46.1	53.9
Southwestern	180,017	22.0	75.5	97.5	2.5	295,465	25.1	73.0	98.1	1.9
North Central	43,350,393	29.5	22.2	51.7	48.3	55,915,636	30.8	22.1	52.9	47.1
Rocky Mountain	1,060,303	24.6	32.2	56.8	43.2	1,512,974	27.9	29.5	57.4	42.6
Pacific Coast	1,391,493	23.5	62.9	86.4	13.6	1,801,631	25.4	62.8	88.2	11.8
	90,715,499	27.6	21.5	49.1	50.9	115,401,728	29.4	21.9	51.3	48.7

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1940–41, in percent

Type of furnace	1940				1941			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth	27.2	18.9	46.1	53.9	29.1	19.3	48.4	51.6
Bessemer	6.1	.2	6.3	93.7	5.0	1.2	6.2	93.8
Electric	43.7	54.5	98.2	1.8	49.6	48.7	98.3	1.7
Cupola	30.2	36.0	66.2	33.8	31.4	34.8	66.2	33.8
Air [1]	41.1	22.2	63.3	36.7	47.8	19.1	66.9	33.1
Crucible	49.5	45.3	94.8	5.2	53.3	41.0	94.3	5.7
Puddling	5.5	19.4	24.9	75.1	5.6	27.8	33.4	66.6
Blast	61.9	38.1	100.0	....	54.7	45.3	100.0	....

[1] Includes data for 3 Brackelsberg furnaces.

Open-hearth and cupola furnaces together consumed 86 percent of the home scrap and 85 percent of both purchased scrap and pig iron in 1941. Bessemer converters used 11 percent of the pig iron consumed in 1941 but only relatively small quantities of scrap (0.66 percent of the total). Although electric furnaces consumed only 7 percent of the total scrap in 1941, 98 percent of the total charge to this type of equipment was home and purchased scrap.

Consumption of ferrous scrap and pig iron in the United States, 1940–41, by type of furnace, in net tons

Type of furnace or equipment	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
1940					
Open-hearth	135	18,320,111	12,687,633	31,007,744	36,297,250
Bessemer	26	248,868	9,322	258,190	3,828,978
Electric	280	1,111,127	1,383,722	2,494,849	46,506
Cupola	2,708	3,657,048	4,372,777	8,029,825	[1] 4,106,119
Air	122	419,771	226,257	646,028	374,187
Brackelsberg	2				
Crucible	25	1,749	1,599	3,348	184
Puddling	7	2,064	7,294	9,358	28,293
Blast	79	1,286,985	793,344	2,080,329	
Direct castings	23				1,504,311
	[2] 3,407	25,047,723	19,481,948	44,529,671	46,185,828
1941					
Open-hearth	139	24,002,629	15,920,857	39,923,486	42,481,404
Bessemer	33	320,738	72,506	393,244	5,993,264
Electric	306	2,109,839	2,068,318	4,178,157	72,758
Cupola	2,798	5,004,864	5,559,273	10,564,137	[1] 5,388,747
Air	128	872,227	349,425	1,221,652	604,835
Brackelsberg	3				
Crucible	14	1,949	1,499	3,448	207
Puddling	8	4,568	22,626	27,194	54,183
Blast	78	1,587,866	1,317,072	2,904,938	
Direct castings	24				1,590,074
	[2] 3,531	33,904,680	25,311,576	59,216,256	56,185,472

[1] Includes some pig iron used in making direct castings.
[2] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY DISTRICTS AND STATES

All 48 States, the District of Columbia, and Alaska contain plants consuming ferrous scrap or pig iron. The greatest consumption, however, is concentrated in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas include the 8 largest consuming States, which used 83 percent of the total scrap, 92 percent of the pig iron, and 87 percent of the total scrap and pig iron charged into furnaces in 1941; these percentages remained unchanged from 1940. These States (the relative position of which did not change from 1940) and the percentage of the total ferrous scrap and pig iron each consumed in 1941 were as follows: Pennsylvania 28, Ohio 20, Indiana 11, Illinois 9, Michigan 5, New York 5, Alabama 5, and Maryland 4.

The following table shows the total consumption of ferrous scrap and pig iron by districts and the percentage change in the use of home scrap, purchased scrap, total scrap, and pig iron from 1937 to 1941.

Consumption of ferrous scrap and pig iron in the United States, 1937–41, by districts

District and year	Active plants reporting	Scrap: Home, Net tons	Scrap: Home, Change from previous year (percent)	Scrap: Purchased, Net tons	Scrap: Purchased, Change from previous year (percent)	Scrap: Total, Net tons	Scrap: Total, Change from previous year (percent)	Pig iron, Net tons	Pig iron, Change from previous year (percent)
New England:									
1937	257	262,011	+31.9	449,901	+3.2	711,912	+12.2	268,295	+23.7
1938	257	140,344	−46.4	250,830	−44.2	391,174	−45.1	145,825	−45.6
1939	263	240,931	+71.7	385,805	+53.8	626,736	+60.2	239,753	+64.4
1940	270	283,607	+17.7	413,993	+7.3	697,600	+11.3	301,997	+26.0
1941	267	489,163	+72.5	566,952	+36.9	1,056,115	+51.4	476,768	+57.9
Middle Atlantic:									
1937	825	7,298,064	+13.0	6,146,227	+7.6	13,444,291	+10.5	14,202,765	+18.9
1938	817	3,882,649	−46.8	2,967,931	−51.7	6,850,580	−49.0	6,617,829	−53.4
1939	835	5,840,586	+50.4	4,660,910	+57.0	10,501,496	+53.3	12,250,912	+85.1
1940	831	8,197,874	+40.4	5,607,105	+20.3	13,804,979	+31.5	17,400,042	+42.0
1941	859	11,472,727	+39.9	7,796,243	+39.0	19,268,970	+39.6	20,787,804	+19.5
Southeastern.									
1937	448	2,415,160	+4.9	2,183,669	−3.8	4,598,829	+.6	5,033,838	+18.6
1938	445	1,765,819	−26.9	1,393,961	−36.2	3,159,780	−31.3	3,827,133	−24.0
1939	470	2,593,437	+46.9	2,019,620	+44.9	4,613,057	+46.0	5,853,055	+52.9
1940	473	3,137,588	+21.0	2,485,652	+23.1	5,623,240	+21.9	6,905,435	+18.0
1941	490	3,761,458	+19.9	2,825,903	+13.7	6,587,361	+17.1	7,699,004	+11.5
Southwestern.									
1937	111	58,078	+46.8	165,435	+28.1	223,513	+32.5	26,771	+242.8
1938	114	39,377	−32.2	110,366	−33.3	149,743	−33.0	5,027	−81.2
1939	131	39,865	+1.2	125,968	+14.1	165,833	+10.7	4,575	−9.0
1940	132	39,674	−.5	135,909	+7.9	175,583	+5.9	4,434	−3.1
1941	139	74,059	+86.7	215,699	+58.7	289,758	+65.0	5,707	+28.7
North Central.									
1937	1,350	11,717,880	+.2	10,286,435	+3.5	22,004,315	+1.7	18,016,942	+7.4
1938	1,333	6,526,443	−44.3	5,759,245	−44.0	12,285,688	−44.2	9,871,485	−45.2
1939	1,374	10,365,278	+58.8	8,468,527	+47.0	18,833,805	+53.3	16,291,065	+65.0
1940	1,377	12,801,283	+23.5	9,622,839	+13.6	22,424,122	+19.1	20,926,271	+28.5
1941	1,424	17,227,439	+34.6	12,329,204	+28.1	29,556,643	+31.8	26,358,993	+26.0
Rocky Mountain									
1937	66	222,943	+19.3	319,004	+10.7	541,947	+14.1	416,878	+15.1
1938	66	101,953	−54.3	161,999	−49.2	263,952	−51.3	152,974	−63.3
1939	68	224,007	+119.7	280,988	+73.5	504,995	+91.3	412,564	+169.7
1940	66	260,825	+16.4	341,269	+21.5	602,094	+19.2	458,209	+11.1
1941	75	421,191	+61.5	446,745	+30.9	867,936	+44.2	645,038	+40.8
Pacific Coast									
1937	231	281,421	−1.6	760,797	−2.2	1,042,218	−2.0	177,821	+9.1
1938	234	223,317	−20.6	582,092	−23.5	805,409	−22.7	104,598	−41.2
1939	252	317,792	+42.3	762,822	+31.0	1,080,614	+34.2	180,775	+72.8
1940	258	326,872	+2.9	875,181	+14.7	1,202,053	+11.2	189,440	+4.8
1941	277	458,643	+40.3	1,130,830	+29.2	1,589,473	+32.2	212,158	+12.0
United States:									
1937	[1] 3,288	22,255,557	+5.1	20,311,468	+3.9	42,567,025	+4.5	38,143,310	+13.1
1938	[1] 3,266	12,679,902	−43.0	11,226,424	−44.7	23,906,326	−43.8	20,724,871	−45.7
1939	[1] 3,393	19,621,896	+54.7	16,704,640	+48.8	36,326,536	+52.0	35,232,699	+70.0
1940	[1] 3,407	25,047,723	+27.7	19,481,948	+16.6	44,529,671	+22.6	46,185,828	+31.1
1941	[1] 3,531	33,904,680	+35.4	25,311,576	+29.9	59,216,256	+33.0	56,185,472	+21.7

[1] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

Consumption of ferrous scrap and pig iron in the United States in 1941, by States and districts

State and district	Active plants reporting	Scrap: Home, Net tons	Scrap: Home, Percent of total	Scrap: Purchased, Net tons	Scrap: Purchased, Percent of total	Scrap: Total, Net tons	Scrap: Total, Percent of total	Pig iron: Net tons	Pig iron: Percent of total
Connecticut	72	150,663	0.5	190,016	0.7	340,679	0.6	143,862	0.3
Maine	20	12,186	(1)	11,361	(1)	23,547	(1)	11,467	(1)
Massachusetts	125	256,882	.8	276,811	1.1	533,693	.9	242,265	.4
New Hampshire	20	6,971	(1)	15,831	.1	22,802	(1)	5,816	(1)
Rhode Island	14	47,694	.1	53,827	.2	101,521	.2	57,082	.1
Vermont	16	14,767	(1)	19,106	.1	33,873	.1	16,276	(1)
Total New England	267	489,163	1.4	566,952	2.2	1,056,115	1.8	476,768	.8
Delaware	10	444,653	1.3	608,765	2.4	1,053,448	1.8	449,486	.8
New Jersey	96								
New York	234	1,714,528	5.1	1,502,402	5.9	3,216,930	5.4	2,765,216	4.9
Pennsylvania	519	9,313,516	27.4	5,685,076	22.5	14,998,592	25.3	17,573,102	31.3
Total Middle Atlantic	859	11,472,727	33.8	7,796,243	30.8	19,268,970	32.5	20,787,804	37.0
Alabama	93	1,386,249	4.1	649,788	2.6	2,036,037	3.4	3,142,958	5.6
District of Columbia	4								
Kentucky	27	1,677,512	4.9	964,615	3.9	2,642,127	4.5	2,974,834	5.3
Maryland	35								
Florida	22	53,716	.2	136,183	.5	189,898	.3	83,895	.1
Georgia	58								
Mississippi	14	941	(1)	2,034	(1)	2,975	(1)	621	(1)
North Carolina	58	20,181	.1	32,177	.1	52,358	.1	18,591	(1)
South Carolina	16	5,803	(1)	6,049	(1)	11,852	(1)	5,090	(1)
Tennessee	62	246,736	.7	298,190	1.2	544,926	.9	254,840	.5
Virginia	65								
West Virginia	36	370,321	1.1	736,867	2.9	1,107,188	1.9	1,218,175	2.2
Total Southeastern	490	3,761,458	11.1	2,825,903	11.2	6,587,361	11.1	7,699,004	13.7
Arkansas	17								
Louisiana	26	25,555	.1	92,298	.4	117,853	.2	2,600	(1)
Oklahoma	23								
Texas	73	48,504	.1	123,401	.5	171,905	.3	3,107	(1)
Total Southwestern	139	74,059	.2	215,699	.9	289,758	.5	5,707	(1)
Illinois	249	2,922,248	8.6	2,322,107	9.1	5,244,355	8.9	4,915,372	8.8
Indiana	162	3,839,965	11.3	2,029,512	8.0	5,869,477	9.9	6,833,091	12.2
Iowa	66	128,791	.4	202,344	.8	331,135	.6	104,368	.2
Kansas	39	20,591	.1	64,166	.3	84,757	.1	4,251	(1)
Nebraska	16								
Michigan	214	2,804,776	8.3	2,043,222	8.0	4,847,998	8.2	2,478,219	4.4
Wisconsin	133								
Minnesota	76	192,508	.6	342,250	1.4	534,758	.9	266,768	.5
Missouri	78	222,556	.7	622,591	2.5	845,147	1.4	80,065	.1
North Dakota	2	1,283	(1)	1,094	(1)	2,377	(1)	86	(1)
South Dakota	3								
Ohio	386	7,094,721	20.9	4,701,918	18.5	11,796,639	19.9	11,676,773	20.8
Total North Central	1,424	17,227,439	50.9	12,329,204	48.6	29,556,643	49.9	26,358,993	47.0
Arizona	8								
Nevada	3	19,059	.1	31,810	.1	50,869	.1	67	(1)
New Mexico	2								
Colorado	31	394,007	1.1	404,420	1.7	798,427	1.4	644,393	1.1
Utah	16								
Idaho	6	706	(1)	2,896	(1)	3,602	(1)	123	(1)
Wyoming	1	3	(1)	1	(1)	4	(1)	2	(1)
Montana	8	7,416	(1)	7,618	(1)	15,034	(1)	453	(1)
Total Rocky Mountain	75	421,191	1.2	446,745	1.8	867,936	1.5	645,038	1.1
Alaska	1								
Oregon	41	67,208	.2	258,225	1.0	325,433	.6	9,830	(1)
Washington	73								
California	162	391,435	1.2	872,605	3.5	1,264,040	2.1	202,328	.4
Total Pacific Coast	277	458,643	1.4	1,130,830	4.5	1,589,473	2.7	212,158	.4
Total United States:									
1941	[2] 3,531	33,904,680	100.0	25,311,576	100.0	59,216,256	100.0	56,185,472	100.0
1940	[2] 3,407	25,047,723	100.0	19,481,948	100.0	44,529,671	100.0	46,185,828	100.0

[1] Less than 0.05 percent.

[2] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY TYPE OF FURNACE

Open-hearth furnaces.—Ferrous scrap and pig iron consumed in open hearths in 1941 totaled 82,404,890 net tons—a 22-percent increase over 1940. Of the 1941 total, home scrap constituted 29 percent, purchased scrap 19 percent, and pig iron 52 percent; in 1940 the percentages were 27, 19, and 54, respectively. The use of home scrap increased 31 percent, purchased scrap 25 percent, and pig iron 17 percent.

Charges to open-hearth furnaces in 1941 consisted of 48 percent total scrap and 52 percent pig iron compared with percentages in 1940 of 46 and 54, respectively. Of the total scrap consumed in open hearths in 1941, 40 percent was purchased scrap compared with 41 percent in 1940 and 44 percent in 1939. Higher proportions of purchased scrap are used in areas remote from pig iron-producing centers, but the practice of using scrap exclusively is relatively rare. In 1941 only 4 plants out of a total of 139 operated upon a 100-percent scrap basis; they consumed only 501,842 tons, less than 1 percent of the total consumption of ferrous raw matrials in open hearths.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1941, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England					
Connecticut	1				
Massachusetts	2	134,958	228,518	363,476	148,899
Rhode Island	1				
Total: 1941	4	134,958	228,518	363,476	148,899
1940	4	74,608	183,901	258,509	94,266
Middle Atlantic:					
Delaware	1				
New Jersey	1	1,429,438	1,150,476	2,579,914	2,480,954
New York	8				
Pennsylvania	51	7,626,806	4,219,437	11,846,243	14,150,089
Total: 1941	61	9,056,244	5,369,913	14,426,157	16,631,043
1940	58	6,570,784	3,805,596	10,376,380	14,250,550
Southeastern and Southwestern					
Alabama	3				
Georgia	1				
Tennessee	1	900,518	446,342	1,346,860	2,305,697
Oklahoma	1				
District of Columbia	1				
Kentucky	2	1,786,399	1,388,150	3,174,549	3,481,905
Maryland	1				
West Virginia	2				
Total: 1941	12	2,686,917	1,834,492	4,521,409	5,787,602
1940	12	2,361,679	1,768,163	4,129,842	5,395,587
North Central					
Illinois	11	2,000,774	1,466,663	3,467,437	3,295,830
Indiana	7	3,363,139	1,673,190	5,036,329	6,172,778
Michigan	4	861,070	757,178	1,618,248	1,259,146
Iowa	1	114,250	409,538	523,788	45,012
Missouri	3				
Minnesota	1	169,456	204,088	373,544	250,043
Wisconsin	2				
Ohio	26	5,058,978	2,946,230	8,005,208	8,174,164
Total: 1941	55	11,567,667	7,456,887	19,024,554	19,196,973
1940	54	8,953,931	6,062,664	15,016,595	16,007,080
Rocky Mountain and Pacific Coast.					
Colorado	1				
California	5	556,843	1,031,047	1,587,890	716,887
Washington	1				
Total: 1941	7	556,843	1,031,047	1,587,890	716,887
1940	7	359,109	867,309	1,226,418	549,767
Total United States: 1941	139	24,002,629	15,920,857	39,923,486	42,481,404
1940	135	18,320,111	12,687,633	31,007,744	36,297,250

Pennsylvania, the leading steel-producing State, outranked all others in 1941 in the consumption of ferrous scrap and pig iron in open hearths, followed by Ohio, Indiana, and Illinois.

Bessemer converters.—The consumption of ferrous scrap and pig iron in bessemer converters in 1941 totaled 6,386,508 net tons—a 56-percent increase over 1940. This large increase in total consumption indicates a revival of the use of bessemer converters for steel making. The proportion of scrap consumed in converter practice is low (amounting to only 6.2 percent in 1941), and the major portion was home or plant scrap. Almost all of the small tonnage of purchased scrap consumed in converters was used in small steel-foundry plants.

Pennsylvania was the principal consumer of scrap in bessemer converters in 1941.

Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1941, by districts and States, in net tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England and Middle Atlantic:					
Connecticut	1				
Delaware	1				
Massachusetts	1	1,508	1,677	3,185	1,626
New Jersey	1				
Pennsylvania	9	106,000	50,580	156,580	2,199,685
Total, 1941	13	107,508	52,257	159,765	2,201,311
1940	12	90,507	2,487	92,994	1,456,966
Southeastern and Southwestern:					
Alabama	1				
Maryland	1				
West Virginia	1	63,088	5,090	68,178	488,351
Louisiana	1				
Texas	1				
Total 1941	5	63,088	5,090	68,178	488,351
1940	4	32,723	1,786	34,509	296,942
North Central and Pacific Coast:					
Illinois	4	5,748	7,607	13,355	549,172
Indiana	1				
Iowa	1	25,714	3,770	29,484	336,686
Michigan	1				
Minnesota	1				
Missouri	1	3,709	3,782	7,491	2,018
Washington	1				
Ohio	5	114,971		114,971	2,415,726
Total: 1941	15	150,142	15,159	165,301	3,303,602
1940	10	125,638	5,049	130,687	2,075,070
Total United States: 1941	33	320,738	72,506	393,244	5,993,264
1940	26	248,868	9,322	258,190	3,828,978

Electric steel furnaces.—Ferrous scrap and pig iron consumed in electric furnaces in 1941 totaled 4,250,915 net tons—a 67-percent increase over 1940. Pig iron constituted less than 2 percent of the total ferrous raw materials used in electric furnaces in 1941. Of the 306 active plants reporting in 1941, 104 operated exclusively on scrap and consumed 751,711 tons—about 18 percent of the total scrap and pig iron used.

Ohio led all States in 1941 in the consumption of scrap in electric furnaces, followed by Pennsylvania, Michigan, Illinois, and New York.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1941, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	4	9,059	10,447	19,506	866
New Hampshire	1				
Rhode Island	1	1,547	776	2,323	38
Vermont	1				
Massachusetts	8	20,340	10,282	30,622	728
Total: 1941	15	30,946	21,505	52,451	1,632
1940	15	17,063	13,062	30,125	720
Middle Atlantic:					
Delaware	1	40,468	58,325	98,793	1,739
New Jersey	6				
New York	18	92,165	113,721	205,886	5,674
Pennsylvania	59	453,189	502,817	956,006	15,311
Total: 1941	84	585,822	674,863	1,260,685	22,724
1940	77	335,005	392,102	727,107	16,264
Southeastern:					
District of Columbia	1				
Kentucky	1	23,720	61,477	85,197	253
Maryland	2				
West Virginia	1				
Alabama	3				
Florida	1	10,927	31,694	42,621	2
Georgia	3				
Tennessee	2	18,560	29,517	48,077	622
Virginia	3				
Total: 1941	17	53,207	122,688	175,895	877
1940	15	27,119	56,613	83,732	445
Southwestern:					
Arkansas	1				
Oklahoma	1	25,167	35,625	60,792	561
Louisiana	4				
Texas	7				
Total: 1941	13	25,167	35,625	60,792	561
1940	13	15,265	21,732	36,997	536
North Central:					
Illinois	23	190,505	202,058	392,563	11,536
Indiana	13	33,919	44,448	78,367	653
Iowa	2				
Kansas	1	7,274	12,784	20,058	83
Nebraska	1				
Michigan	24	245,984	165,678	411,662	17,114
Minnesota	4	4,658	10,462	15,120	395
Missouri	10	10,478	14,437	24,915	993
Ohio	35	776,556	524,355	1,300,911	10,891
Wisconsin	13	70,388	90,534	160,922	4,271
Total: 1941	126	1,339,762	1,064,756	2,404,518	45,936
1940	111	672,856	830,132	1,502,988	27,826
Rocky Mountain:					
Arizona	2				
Colorado	2	10,337	15,150	25,487	118
Nevada	1				
Utah	1				
Total: 1941	6	10,337	15,150	25,487	118
1940	6	6,784	8,859	15,643	100
Pacific Coast:					
Alaska	1	5,450	9,939	15,389	13
Oregon	4				
California	26	46,839	89,983	136,822	858
Washington	14	12,309	33,809	46,118	39
Total: 1941	45	64,598	133,731	198,329	910
1940	43	37,035	61,222	98,257	615
Total United States: 1941	306	2,109,839	2,068,318	4,178,157	72,758
1940	280	1,111,127	1,383,722	2,494,849	46,506

Cupola furnaces.—Consumption of ferrous scrap and pig iron in cupola furnaces in 1941 totaled 15,952,884 net tons—a 31-percent increase over 1940. Use of home scrap increased 37 percent, purchased scrap 27 percent, total scrap 32 percent, and pig iron 31 percent. Thus, the proportionate increase in the use of purchased scrap was less than that of pig iron, although the prices of scrap were relatively lower as compared with pig iron. This lower proportion of purchased scrap was undoubtedly caused by difficulty in obtaining cast scrap.

Charges to cupola furnaces in 1941 consisted of 31 percent home scrap, 35 percent purchased scrap, and 34 percent pig iron; in 1940 the percentages were 30, 36, and 34, respectively. Many cupola plants operate on a 100-percent scrap charge; a total of 511 plants reported the use of 922,685 tons of ferrous scrap without pig iron in 1941 compared with 456 plants that reported the use of 1,086,456 tons in 1940.

The relative position of States that are large consumers of scrap in cupola furnaces was not changed in 1941. Michigan continued to be the principal consumer, followed in order by Ohio, Pennsylvania, Illinois, and New York.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1941, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England.					
Connecticut	58	94,712	62,008	156,720	95,964
Maine	20	12,186	11,361	23,547	11,467
Massachusetts	108	112,657	147,149	259,806	134,289
New Hampshire	17	3,437	14,719	18,156	4,024
Rhode Island	11	28,733	28,507	57,240	32,772
Vermont	15	14,748	19,106	33,854	16,276
Total: 1941	229	266,473	282,850	549,323	294,792
1940	228	160,459	199,295	359,754	185,297
Middle Atlantic:					
Delaware	6	3,350	5,883	9,233	3,423
New Jersey	84	183,065	310,060	493,125	249,143
New York	187	276,773	326,876	603,649	300,203
Pennsylvania	336	455,672	544.396	1,000,068	629,041
Total. 1941	613	918,860	1,187,215	2,106,075	1,181,810
1940	596	632,299	1,038,005	1,670,304	858,228
Southeastern:					
Alabama	79	319,582	219,897	539,479	850,063
District of Columbia Maryland	2 30	60,708	63,384	124,092	71,106
Florida	21	1,676	5,320	6,996	654
Georgia	54	24,082	40,157	64,239	33,607
Kentucky	22	39,479	32,279	71,758	92,037
Mississippi	12	941	2,034	2,975	621
North Carolina	58	20,181	32,177	52,358	18,591
South Carolina	16	5,803	6,049	11,852	5,090
Tennessee	60	154,248	120,349	274,597	204,340
Virginia	61	72,470	145,775	218,245	49,396
West Virginia	26	10,595	25,608	36,203	12,152
Total 1941	441	709,765	693,029	1,402,794	1,337,657
1940	425	478,181	547,552	1,025,733	1,153,971
Southwestern:					
Arkansas	16	1,186	4,435	5,621	181
Louisiana	21	2,700	7,532	10,232	715
Oklahoma	20	5,112	12,543	17,655	1,424
Texas	64	27,349	102,818	130,167	981
Total: 1941	121	36,347	127,328	163,675	3,301
1940	116	19,335	96,269	115,604	2,901

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1941, by districts and States, in net tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
North Central:					
Illinois	187	467,110	479,029	946,139	384,913
Indiana	126	239,874	266,944	506,818	248,494
Iowa	60	102,652	122,482	225,134	70,361
Kansas	38	14,737	50,911	65,648	2,027
Michigan	171	1,103,762	658,937	1,762,699	839,725
Minnesota	66	32,754	98,747	131,501	21,859
Missouri	63	106,436	264,513	370,949	56,796
Nebraska	15	4,867	10,638	15,505	2,223
North Dakota	2	1,283	1,094	2,377	86
South Dakota	3				
Ohio	269	499,295	647,854	1,147,149	572,636
Wisconsin	108	264,638	272,163	536,801	237,844
Total 1941	1,108	2,837,408	2,873,312	5,710,720	2,436,964
1940	1,083	2,194,806	2,213,419	4,408,225	1,818,120
Rocky Mountain:					
Arizona	6	9,531	23,506	33,037	
Colorado	25	20,289	53,456	73,745	41,543
Idaho	6	706	2,896	3,602	123
Montana	8	7,416	7,618	15,034	453
Nevada	2	3,699	3,535	7,234	52
New Mexico	2				
Wyoming	1	3	1	4	2
Utah	14	29,353	51,456	80,809	28,248
Total: 1941	64	70,997	142,468	213,465	70,421
1940	56	35,603	85,351	120,954	45,740
Pacific Coast:					
California	128	141,062	186,768	327,830	56,707
Oregon	37	7,611	20,750	28,361	3,292
Washington	57	16,341	45,553	61,894	3,803
Total 1941	222	165,014	253,071	418,085	63,802
1940	204	136,365	192,886	329,251	41,862
Total United States: 1941	2,798	5,004,864	5,559,273	10,564,137	[1] 5,388,747
1940	2,708	3,657,048	4,372,777	8,029,825	[1] 4,106,119

[1] Includes some pig iron used in making direct castings.

Air furnaces.—Ferrous scrap and pig iron consumed in air furnaces in 1941 amounted to 1,826,487 net tons—a 79-percent increase over 1940. The use of home scrap increased 108 percent, of purchased scrap 54 percent, and of pig iron 62 percent; the use of total scrap increased 89 percent. Thus, equipment of this type used relatively more pig iron than purchased scrap in 1941, in contrast with 1940 when the relative increase in use of both was identical. No air-furnace operators reported exclusive use of scrap in 1941, whereas in 1940 4 reported the use of 15,673 tons.

Ohio led all States in 1941 in the consumption of scrap in air furnaces, followed in order by Illinois, Pennsylvania, Indiana, Michigan, New York, and Wisconsin.

Consumption of ferrous scrap and pig iron in air furnaces [1] *in the United States in 1941, by districts and States, in net tons*

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	7	23,658	5,114	28,772	15,334
Massachusetts	8				
New Hampshire	1	21,476	10,101	31,577	15,864
Rhode Island	1				
Total: 1941	12	45,134	15,215	60,349	31,198
1940	12	23,714	9,224	32,938	21,337
Middle Atlantic:					
Delaware	1	13,796	2,829	16,625	9.771
New Jersey	2				
New York	13	68,549	25,111	93,660	45,165
Pennsylvania	25	110,606	50,056	160,662	96,826
Total: 1941	41	192,951	77,996	270,947	151,761
1940	40	105,786	60,712	166,498	90,576
Southeastern and Southwestern:					
West Virginia	3	11,571	6,656	18,227	6,984
Texas	1				
Total: 1941	4	11,571	6,656	18,227	6,984
1940	4	7,813	15,613	23,426	5,401
North Central:					
Illinois	15	240,084	96,095	336,179	167,553
Indiana	11				
Michigan	9	98,110	43,285	141,395	61,700
Iowa	1				
Minnesota	1	14,913	4,938	19,851	14,465
Missouri	1				
Ohio	22	211,007	91,061	302,068	119,669
Wisconsin	10	53,851	12,855	66,706	46,525
Total: 1941	70	617,965	248,234	866,199	409,912
1940	65	279,822	139,905	419,727	254,388
Rocky Mountain and Pacific Coast:					
Colorado	2	4,606	1,324	5,930	4,980
California	2				
Total: 1941	4	4,606	1,324	5,930	4,980
1940	3	2,636	803	3,439	2,485
Total United States: 1941	131	872,227	349,425	1,221,652	604,835
1940	124	419,771	226,257	646,028	374,187

[1] Includes 3 Brackelsberg furnaces, 1 each in Indiana, Ohio, and Michigan.

Crucible and puddling furnaces.—Crucible and puddling furnaces, whose combined output of iron and steel is very small, consume only minor quantities of ferrous raw materials.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1941, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	1	861	854	1.715	6
Massachusetts	2				
New Hampshire	1				
Total: 1941	4	861	854	1.715	6
1940	9	949	1,067	2,016	29
Middle Atlantic and Southeastern:					
New Jersey	2	1,952	5,102	7,054	16,106
Kentucky	1				
Pennsylvania	10	3,566	17,862	21,428	38,119
Total: 1941	13	5,518	22,964	28,482	54,225
1940	14	2,683	7,666	10,349	28,381
North Central: Ohio	3	53	8	61	59
Total: 1941	3	53	8	61	59
1940	7	163	140	303	67
Pacific Coast and Southwestern:					
California	1	85	299	384	100
Oklahoma	1				
Total: 1941	2	85	299	384	100
1940	2	18	20	38	----------
Total United States: 1941	22	6,517	24,125	30,642	54,390
1940	32	3,813	8,893	12,706	28,477

Blast furnaces.—Ferrous scrap constitutes only a small proportion of the metal-bearing materials consumed in blast furnaces. The other materials used in 1941 were 94,404,667 net tons of iron and manganiferous iron ores, 6,858,576 tons of cinder and scale, and 3,983,000 tons of flue dust. Total consumption of scrap in 1941, as reported by 78 plants operating blast furnaces, was 2,904,938 tons, a 40-percent increase over 1940. Of the 1941 total, 55 percent was home scrap and 45 percent purchased scrap.

The proportion of scrap used in blast furnaces increased in 1941, amounting to 5.3 percent of the pig iron produced in 1941 compared with 4.5 percent in 1940 and 5.6 percent in 1939. Purchased scrap was equivalent to 2.4 percent of the pig iron produced in 1941 compared with 1.7 percent in 1940 and 2.3 percent in 1939.

Blast furnaces in Ohio continued to consume more scrap than those in any other State and in 1941 used 8 percent more than Pennsylvania, the second ranking State; in 1940, Ohio furnaces consumed 3 percent more than Pennsylvania furnaces.

Consumption of ferrous scrap in blast furnaces in the United States in 1941, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total
New England and Middle Atlantic:				
Massachusetts New York	1 6	59,809	133,597	193,406
Pennsylvania	21	557,677	299,928	857,605
Total: 1941	28	617,486	433,525	1,051,011
1940	28	468,072	309,951	778,023
Southeastern:				
Alabama	6	190,915	91,475	282,390
Kentucky	1		16,511	16,511
Maryland	1	44,619	37,562	82,181
Tennessee	1	704		704
Virginia	1			
West Virginia	2	12,261	66,666	78,927
Total 1941	12	248,499	212,214	460,713
1940	13	234,699	111,863	346,562
North Central:				
Illinois	5	130,695	114,834	245,529
Indiana	3	66,347	751	67,098
Iowa [1]	1		250	250
Michigan	5	77,890	23,129	101,019
Minnesota	2	5,759	39,500	45,259
Ohio	20	433,861	492,410	926,271
Total: 1941	36	714,552	670,874	1,385,426
1940	36	574,067	371,530	945,597
Rocky Mountain.				
Colorado Utah	1 1	7,329	459	7,788
Total 1941	2	7,329	459	7,788
1940	2	10,147		10,147
Total United States: 1941	78	1,587,866	1,317,072	2,904,938
1940	79	1,286,985	793,344	2,080,329

[1] Electric furnace.

FOREIGN TRADE [5]

Statistics on foreign trade during 1941 are not available for publication, except totals covering the period from January through September. Therefore no accurate conclusions or comparisons with previous years can be made.

Imports.—Imports of iron and steel scrap into the United States, which never have been very significant, totaled 52,429 net tons valued at $503,100 during the period from January through September 1941. In 1940, 2,199 tons valued at $47,979 were imported. Of the 1941 partial total, 27,822 tons came from Cuba, 17,601 from Canada, 2,317 from Colombia, 1,859 from Curaçao (N. W. I.), 1,117 from Surinam, 756 from Europe (mainly Czechoslovakia), 736 from Bermuda, and only 221 from other countries. In addition, 17,908 tons of tin-plate scrap were imported during the first 9 months of 1941, largely from Canada. In 1940 imports of tin-plate scrap totaled 18,609 tons compared with 14,149 in 1939.

Exports.—Ferrous scrap exports (all types) from the United States during the January–September period of 1941 totaled only 696,110 net tons valued at $12,050,641. In 1940, 3,159,284 tons valued at $48,314,146 were exported. The low exportation in 1941 was caused

[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

by license proclamations issued during the latter part of 1940 restricting exports of all grades of scrap, except to Great Britain and countries of the Western Hemisphere. The shipments in 1941 included 9,989 tons of tin-plate scrap, waste-waste tin plate, tin-plate strips, cobbles, etc., valued at $654,946. In 1940, exports of this type of scrap totaled 15,923 tons valued at $753,184. The following table shows the principal countries to which shipments of scrap were consigned during the 5-year period 1936–40.

Ferrous scrap exported from the United States, 1936–40, by countries, in net tons

Country	1936	1937	1938	1939	1940
Canada	71,357	207,840	103,283	196,556	411,571
Germany	7,615	98,731	258,611	18,574	
Italy	319,341	427,161	486,883	477,004	357,627
Japan	1,184,536	2,140,889	1,547,617	2,279,315	1,079,141
Netherlands	5,350	160,609	231,341	60,665	165
Poland and Danzig	34,837	308,680	109,625	173,161	
United Kingdom	408,659	948,838	433,829	569,288	1,100,774
Other countries	136,773	300,987	127,233	240,009	210,006
	2,168,468	4,593,735	3,358,422	4,014,572	3,159,284
Total value	$24,684,084	$79,387,459	$45,829,533	$55,911,516	$48,314,146

Exports were drawn largely from seaboard areas where the cost of transportation from the point of origin to the port of exportation is relatively low and where the cost of transportation to domestic iron and steel plants not within the area is high.

WORLD ASPECTS

Statistics on world steel and pig-iron production in 1941 are not available, as publication of information has been suspended in many countries. However, as iron and steel are essential to the military forces, world steel and pig-iron production undoubtedly was considerably increased, and the demand for iron and steel scrap was greater than at any previous time.

CARTEL ACTIVITIES

All agencies that formerly operated on behalf of groups of countries suspended operations after the advent of war in 1939, hence there was no activity for the purchase of iron and steel scrap by any cartel for individual nations. Throughout 1941 each nation that purchased scrap bought independently; the pro-Axis nations procured no scrap, and the democracies received less scrap than in 1940.

REVIEW BY COUNTRIES

Canada.—Steel production in Canada reached new high levels in 1941, when the output of steel ingots and castings totaled 2,701,000 net tons, an increase of approximately 20 percent over the previous record of 2,256,000 tons established in 1940. Canadian pig-iron production also increased in 1941 but not to the extent of the increase in steel production, indicating that the steel industry was more dependent on supplies of iron and steel scrap to establish the new record. Production of pig iron in 1941 totaled 1,528,000 tons compared with the previous record of 1,309,000 tons established in 1940, an increase of

less than 17 percent.[6] This increased production of steel and pig iron occasioned alarm regarding the scrap supply since, with the greater demand that at times exceeded the supply, dealers could not increase their yard stocks, and some consumers were compelled to deplete stock piles to maintain production.[7]

On February 17 1941, iron and steel scrap was placed under the direct control of the Canadian Steel Controller, and maximum prices for steel scrap only were issued. This measure was instituted to relieve the price situation and to insure the maximum flow of scrap through domestic channels.[8] Then, on July 10, 1941, the Steel Controller also established a maximum price schedule for cast-iron scrap to assure a steady flow of this material to foundries and to stabilize prices.[9] During the last quarter of the year the entire iron and steel scrap industry was placed under Government control, under which all dealers were required to procure a license from the Steel Controller, comply with maximum prices, and submit monthly reports.[10] The program instituted in 1940 by the Dominion Government, to collect agricultural scrap, as well as old ship hulls, automobile scrap, and railroad material in the maritime Provinces and rural districts, was continued and enlarged to include industrial concerns, municipal governments, and the civilian population.[11] To utilize supplies of scrap metal that accumulated in British Columbia, as a consequence of the embargo on exports and the difficulty of transporting scrap to consuming centers, the Government endorsed the establishment of a steel plant in which scrap would be utilized exclusively.[12] No iron and steel scrap has been exported from Canada since late in 1939, except to the United Kingdom and to nations of the Western Hemisphere. Consequently, exports have decreased considerably, whereas imports from the United States have steadily increased.

Germany.—Statistics on the production of steel and pig iron and on the consumption of scrap in Germany are not available. However, as a result of annexation and military occupancy of European countries, steel-ingot capacity is estimated as more than double what it was before the war.[13] The German Government issued a decree curtailing the use of iron and steel in many commodities, except in goods to be used for military or hospital purposes.[14] Decrees were also issued in German-dominated countries regulating the use and disposal of scrap materials. Iron and steel scrap was shipped from such countries for use in the manufacture of war materials.[15]

Japan.—The prohibition by the United States of exports of iron and steel scrap to Japan caused a revision of technique in the iron and steel industry.[16] The main point in the revised plans included the increased manufacture of equipment for the production of steel from pig iron, thereby using little or no scrap. Some small success was attained in furnaces of low capacity in producing steel using approximately 15 percent scrap and 85 percent pig iron, as compared with previous practice when these percentages were 45 and 55, re-

[6] Iron Age, vol. 149, No. 6, February 5, 1942, p. 109.
[7] American Metal Market, vol. 48, No. 217, November 11, 1941, p. 8.
[8] Waste Trade Journal, vol. 70, No. 25, March 29, 1941, pp. 77, 79, 81.
[9] American Metal Market, vol. 48, No. 137, July 17, 1941, p. 7.
[10] Foreign Commerce Weekly, vol. 5, No. 6, November 8, 1941, p. 23.
[11] American Metal Market, vol. 48, No. 227, November 27, 1941, p. 7.
[12] Waste Trade Journal, vol 70, No. 26, April 5, 1941, p. 26.
[13] Metals and Alloys, vol. 12, No. 1, January 1942, p. 114.
[14] American Metal Market, vol. 48, No. 91, May 10, 1941, p. 6.
[15] Daily Metal Reporter, vol. 41, No. 98, May 21, 1941, p. 10.
[16] Waste Trade Journal, vol. 70, No. 13, January 4, 1941, p. 26.

spectively. In view of the scarcity of scrap the Ministry of Commerce decided to request steel-manufacturing companies to use a ratio of 70 percent pig iron to 30 percent scrap in the production of steel.[17] To offset the loss of scrap imports, the Government intensified scrap-collection efforts, and such material as railway cars, posts, kitchen utensils, gutters, pipes, and manhole covers was salvaged. Fences around Government and business buildings were salvaged, as were the numerous ships that have been wrecked in nearby Japanese-controlled areas.[18] The iron and steel industrial policy as regards the purchase and distribution of scrap iron, which had been inaugurated previously, was extended to provide for closer control of the allotment of iron and steel raw materials.

United Kingdom.—Scrap remained an extremely significant factor in the production of steel in the United Kingdom in 1941, especially since operations at iron and steel mills were conducted at or near record levels throughout the year. Imports of scrap from the United States continued until September, when a decision was reached to discontinue the exportation of scrap materials from the United States to Great Britain.[19] House-to-house collection campaigns were continued and produced sizable quantities of scrap. In addition to these collections, scrap was being salvaged from buildings damaged by the enemy, derelict factories, abandoned railroad and street-car installations, and other sources of supply. Buildings damaged by bombs yielded large quantities of iron and steel scrap, offsetting the curtailment of imports. Local authorities were instructed to compile a list of all unnecessary gates and railings, with the exception of those serving a safety purpose or having historic interest or artistic merit.[20] These measures tended to increase the supply of scrap material, with the result that at the end of the first half of the year stocks of iron and steel scrap were approximately 50 percent larger than during 1940, and adequate supplies were available throughout the entire year 1941.[21]

The British Ministry of Supply issued Control of Iron and Steel (Scrap) Order 14, which decreed complete control over all buying and selling of scrap.[22] This decree regulated the acquisition or disposition of scrap except by license; exports of scrap were also prohibited except under license issued by the Export Licensing Department of the Board of Trade. In conjunction with this decree, maximum prices were established covering all sales of iron and steel scrap. Toward the close of the year the scrap-collection drives were placed upon a firmer national basis and were being directed by the Ministry of Works and Buildings with plans made to grant the Ministry power to commandeer obsolete property of all descriptions.[23] With a view to conserving raw materials, manufacture of a large list of items from steel was restricted, including metal windows, beds, springs, furniture, buttons, buckles, and sundry manufactures.[24] In the production of pig iron less scrap was employed in blast furnaces because of an increased use of home-produced iron ores.

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[17] Foreign Commerce Weekly, vol. 4, No. 2, July 12, 1941, p. 14.
[18] Waste Trade Journal, vol. 72, No. 4, November 1, 1941, p. 15.
[19] American Metal Market, vol. 48, No. 169, August 30, 1941, p. 1.
[20] Iron and Coal Trades Review, vol. 143, No. 3836, September 5, 1941, p. 217.
[21] Iron Age, vol. 147, No 26, June 26, 1941, p. 98.
[22] Waste Trade Journal, vol. 70, No. 25, March 29, 1941, pp. 105, 107, 113.
[23] Iron Age, vol. 148, No. 25, December 18, 1941, p. 131.
[24] American Metal Market, vol. 48, No. 110, June 7, 1941, p. 6.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By Norwood B. Melcher [1]

SUMMARY OUTLINE

GENERAL FEATURES IN 1941

The domestic steel industry operated at record levels throughout 1941. Production was maintained at a rate well above 90 percent, in spite of the fact that the capacity increased considerably. The average operating rate for the entire year was 97.3 percent, and 82,839,259 net tons of steel were produced. This great activity in steel manufacture was reflected in the iron ore and pig iron industries during 1941. Domestic production of pig iron, exclusive of ferro-alloys, increased 19 percent over 1940 and established a new record of 55,085,446 net tons—an increase of 18 percent over the previous peak year 1929. Iron ore, exclusive of ore containing 5 percent or more manganese, likewise experienced a record year in 1941, and a total of 92,409,579 gross tons was mined—an increase of 25 percent over 1940 and 23 percent more than in the previous peak year 1917. However, iron ore is an essential raw material in our great war-production drive, and 1941 is not expected to retain its laurels long. If announced objectives are reached, iron-ore production in 1942 should easily pass the 100,000,000-ton mark; and steel production of 85,000,000 tons and a considerable increase in pig-iron output are anticipated.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States 1940–41

	1940		1941	
	Gross tons	Value	Gross tons	Value
Iron ore:				
Production by—				
Districts:				
Lake Superior	[1] 61,471,323	([2])	[3] 78,858,332	([2])
Southeastern and Southwestern	[4] 7,446,103		8,145,900	
Northeastern	3,559,924		3,962,072	
Western	1,218,549		[4] 1,443,275	
	73,695,899	([2])	92,409,579	([2])
Mining methods:				
Open pit	[5] 49,591,309	([2])	[5] 65,192,237	([2])
Underground	[5] 24,104,590		[5] 27,217,342	
	73,695,899	([2])	92,409,579	([2])
Varieties:				
Hematite	[6] 68,869,837	([2])	[7] 86,725,406	([2])
Brown ore	[8] 934,625		1,366,849	
Magnetite	[6, 8] 3,890,924		[7] 4,316,718	
Carbonate	513		606	
	73,695,899	([2])	92,409,579	([2])
Shipments (exclusive of ore for paint)	75,198,084	$189,086,799	93,053,994	$249,705,903
Average value per ton at mine		2.51		2.68
Stocks at mines Dec. 31	3,613,742	([2])	3,592,141	([2])
Imports	2,479,326	6,204,641	[9] 1,707,811	[9] 3,917,452
Exports	1,386,304	4,624,555	[9] 1,347,641	[9] 4,362,806
Pig iron:				
Production	41,253,542	([2])	4[illegible],183,434	([2])
Shipments	41,927,615	840,442,032	49,306,822	1,111,811,316
Average value per ton at furnaces		20.05		22.55
Imports	10,242	189,379		
Exports	553,871	13,057,901	[9] 458,537	[9] 14,081,065
Ferro-alloys:				
Production	1,093,179	([2])	([10])	([2])
Shipments:				
Ferromanganese	449,367	42,755,485	([10])	([10])
Spiegeleisen	106,707	3,487,565		
Ferrosilicon	429,494	24,027,652		
Other varieties	168,593	57,857,108		
	1,154,161	128,127,810	([10])	([10])
Imports:				
Ferromanganese	10,369	1,321,369	[9] 3,579	[9] 325,102
Spiegeleisen	15,585	638,732	[9] 2,911	[9] 119,524
Ferrosilicon	9,158	262,397	[9] 9,054	[9] 337,789
Steel production:				
Open-hearth:				
Basic	54,359,679	([2])	65,457,903	([2])
Acid	616,288		961,400	
Bessemer	3,311,226		4,980,420	
Crucible	914		2,065	
Electric	1,517,863		2,561,836	
	59,805,970	([2])	73,963,624	([2])

[1] Includes a small quantity of ore produced in southern Wisconsin.
[2] Figures not available.
[3] Includes a small quantity of ore produced in southern Minnesota.
[4] Texas included with Southeastern and Southwestern districts in 1940 and included in Western in 1941.
[5] Some underground included with open pit.
[6] Small quantity of hematite included with magnetite.
[7] Small quantity of magnetite included with hematite.
[8] Small quantity of brown ore included with magnetite.
[9] Figures cover January–September, inclusive.
[10] Figures not available for publication.

Figure 1 shows the trends in domestic production of iron ore, pig iron, and steel since 1880.

Steel-consuming industries.—The automobile industry, although called upon to convert to war production during the latter months of the year, ranked second only to the construction industry in the consumption of steel during 1941. The production of automobiles in 1941 increased 8 percent over 1940 and totaled 4,838,561 units, which was only slightly below the 5-million-car year 1929. The automobile and aircraft industries consumed 6,392,202 net tons (10.2 percent) of the total (62,484,162 tons) consumed and exported. The construction industry experienced great activity during the year, using 8,127,889 tons or 13.0 percent of the total. The additions to arms-

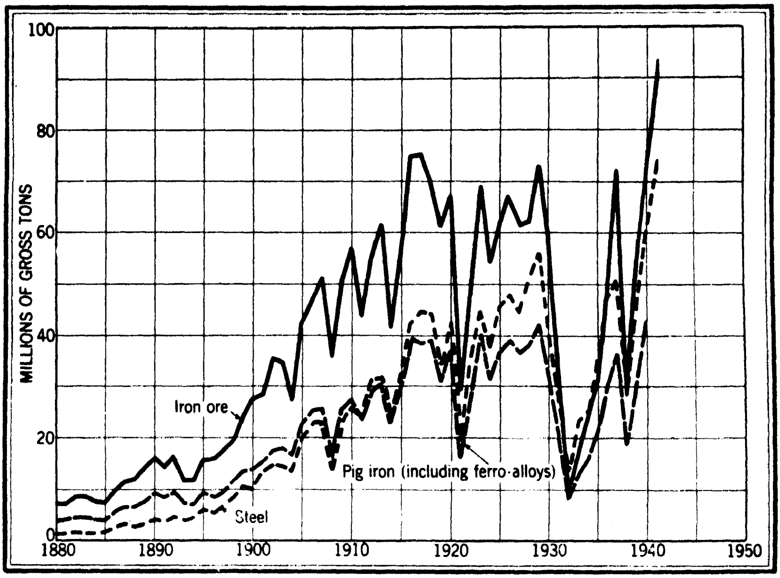

FIGURE 1.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1941.

production capacity during 1941 were almost exclusively in the form of new plants rather than the conversion of existing facilities.

The large volume of capital in hands of consumers made available through the increased output of steel was instrumental in raising the Nation's purchasing power to high levels. Consumers' demands were directed particularly to durable goods; in consequence, these articles were produced in extraordinary quantity during the first 9 months of the year. In the final months, shortages of raw materials forced curtailment in output of private consumers' goods. By the beginning of 1942, the new military program pointed to virtual elimination of all such production through control over uses of materials and conversion of whole industries to war production.

The farm-machinery industry had a record year in 1941. The industry was granted favorable priority for raw materials and drew heavily on steel products. Output of railroad cars—another major type of equipment—was hampered during much of 1941 by shortage of materials, especially steel plates. Production was 65,317 cars (not includ-

ing output of private car shops), about one-third more than in 1940, but this was far short of needs. Approximately 993 locomotives were built compared with 646 in 1940, and output trended toward Diesel and Diesel-electric units. The most dramatic advance in output during the year appeared in certain industries engaged directly in manufacturing finished arms. In the first stages of the armament program, emphasis was placed on planes and ships as the most urgently needed types of war materials, and it was in these arms categories that heaviest volume production was achieved by the year end. The number of naval ships completed during the year is not published, but deliveries of merchant tonnage aggregating 749,000 gross tons were almost 70 percent more than the 445,000 gross tons completed in 1940. Output of airplanes averaged more than 1,500 monthly (using only 9 months' figures) compared with 500 units a month average in the preceding year. However, these figures are dwarfed by the goal of 60,000 fighting planes and 8,000,000 dead-weight tons of merchant shipping set by the President early in 1942 to be produced before the end of this year.

The following table shows the distribution of steel to consuming industries during 1941.

Distribution of steel to consuming industries in 1941 [1]

	Net tons	Percent of total
Steel converting and processing industries:		
Wire drawers and wire product manufacturers	535,741	
Bolt, nut, and rivet manufacturers	1,160,767	
Forging manufacturers	1,144,442	
All other steel plants and foundries	1,956,853	
Total	4,797,803	7.7
Jobbers, dealers and distributors:		
Oil and natural-gas industry	1,018,371	
All other	8,181,440	
Total	9,199,811	14.7
Construction industry:		
Public (municipal, State, national)	518,555	
Highways	708,613	
Railways	102,494	
Automotive and aircraft	406,463	
Utilities	515,003	
Building trim, accessories and builders' hardware	1,020,109	
All other	4,856,652	
Total	8,127,889	13 0
Shipbuilding industry	2,733,413	4.4
Pressing, forming and stamping industry.		
Metal furniture and office equipment	676,944	
Hardware and household equipment	1,746,810	
All other	3,897,782	
Total	6,321,536	10.1
Container industry:		
Oil and natural-gas industry	437,367	
All other	4,052,043	
Total	4,489,410	7.2
Agricultural, including implement and equipment manufacturers	1,153,678	1.8
Machinery and tools:		
Machinery and tools, excluding electrical equipment	1,569,712	
Electrical machinery and equipment	1,301,275	
Total	2,870,987	4.6
Automotive and aircraft industry	6,392,202	10.2

[1] American Iron and Steel Institute.

Distribution of steel to consuming industries in 1941—Continued

	Net tons	Percent of total
Railroad industry:		
All railroads	3,533,866	
Car and locomotive builders and parts manufacturers	2,146,935	
Total	5,680,801	9.1
Oil, natural-gas, and mining industry:		
Oil and natural gas, including pipe lines	1,735,983	
Mining, quarrying, and lumbering	249,157	
Total	1,985,140	3.2
Miscellaneous industries and export	8,731,492	14.0
Total	62,484,162	100.0

Prices.—The composite price of finished steel, as compiled by Iron Age, remained constant at 2.30467 cents (revised figure) a pound throughout 1940 and 1941. Prices of No. 1 Heavy-Melting scrap at Pittsburgh started at $19.76 a net ton in January, dropped to $18.75 in February, and beginning in May remained at $17.86, the price maximum set by the Office of Price Administration. Pig iron held at $20.94 a net ton during January and February, rose to $21.01 in March, and remained thereafter at $21.08, the composite maximum price.

The price of ferromanganese at seaboard was held by maximum price regulation at $107.14 a net ton throughout 1941. Spiegeleisen, as quoted by Steel, continued at $32.14 a ton during the year. Prices of Lake ores have remained constant since April 17, 1940.

Figure 2 gives trends in prices of iron ore, pig iron, steel and steel scrap since 1890.

Employment and wages.—According to the American Iron and Steel Institute, steel pay rolls totaled $1,301,000,000 in 1941 compared with $961,000,000 in 1940 and only $841,000,000 in 1929. Hourly wages in 1941 averaged 95.9 cents an hour compared with 85 cents in 1940. Employment rose 86,000 during the year to a record total of 633,000. During 1941, steel workers averaged 38.6 hours a week. Total employment in all industries (excluding the armed forces) rose to 49.5 million in December 1941. In all, about 3 million were added to the employment list during the year. The real income of workers increased during 1941 despite higher living costs. An increase in hours worked a week and in wage rates during the year was accompanied by a marked increase in the number of industrial disputes.

Meeting demand for steel.—During 1941, domestic steel capacity was increased 4,418,000 net tons to a record total of 88,570,000 tons. Since January 1940 steel capacity has increased 6,950,000 tons, almost equal to Japan's total 1940 production of 7,100,000 tons.

The increase in open-hearth capacity was 3,542,000 tons and in electric furnace capacity 1,151,000 tons, whereas bessemer-steel capacity declined from 6,997,000 tons to 6,721,000 tons.

Blast-furnace capacity increased 2,784,000 tons during 1941 to a record total of 60,394,000 net tons. This capacity was made possible by the addition of five new blast furnaces and the return to service of five furnaces that had been long idle.

United States Government regulations regarding expansion of iron and steel capacity are promulgated by the Iron and Steel Industrial Branch, Division of Materials, War Production Board. The Division of Materials was set up as an operating division in the Office of Production Management by the O. P. M. Council on September 4, 1941, with the approval of the President. It represents an amalgamation of certain commodity sections (of which iron and steel is one) of the Production and Priorities Division, dealing with industrial materials.

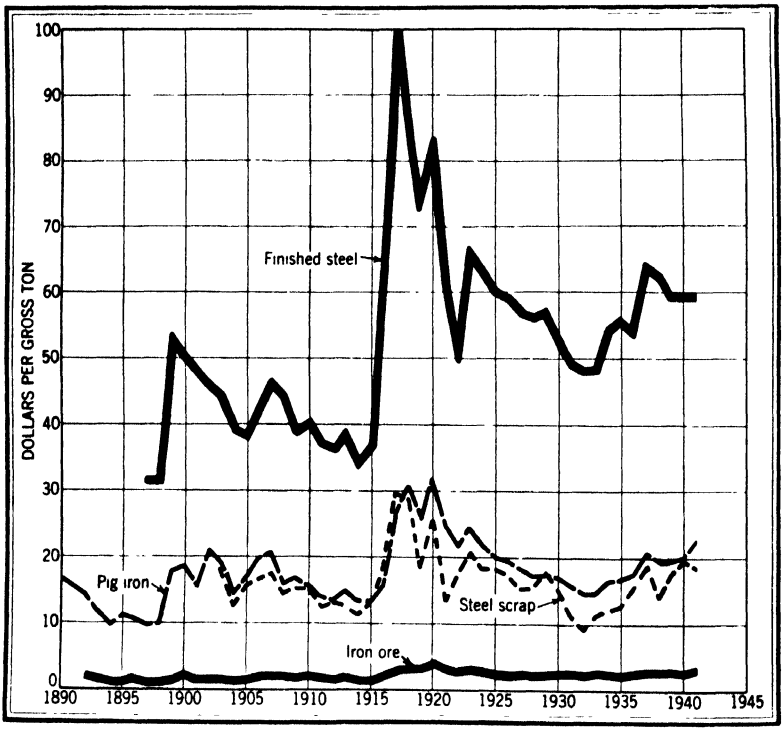

FIGURE 2.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1890–1941 The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No 1 Heavy Melting, computed by Iron Age.

Functions of the Division of Materials in the War Production Board are virtually unchanged from those it held in the Office of Production Management. The War Production Board was established January 16, 1942.

In fulfilling its functions, the branch formulates policies and recommends means for expanding and developing domestic sources, for purchasing, stock-piling, and assuring as great a supply of raw materials as possible, and for expediting production of iron and steel.

Foreign trade.—Because of war-time censorship, imports and exports for only 9 months of 1941 may be shown.

Statistics relating to imports and exports for 9 months of 1941 may be found under discussion of foreign trade in iron ore, pig iron, ferroalloys, and steel.

CONSUMPTION OF FERROUS SCRAP AND PIG IRON

Data on the consumption of ferrous scrap and pig iron, formerly included in this chapter, will be found in the chapter on Iron and Steel Scrap. Data on the consumption of pig iron will be found n the pig-iron section of this chapter.

IRON ORE

PRODUCTION AND SHIPMENTS

Iron-ore mining in the United States experienced its best year on record during 1941. Production totaled 92,409,579 gross tons—a gain of 25 percent over 1940. Output in 1941 came from 276 [2] mines, of which 18 produced more than 1 million tons each compared with 230 [2] mines and 15 in the million-ton class in 1940. Twenty States were active producers in 1941 compared with 19 in 1940. Minnesota, with 62,750,907 tons, supplied 68 percent of the domestic total; and Michigan, with 14,671,192 tons or 16 percent, was the second-largest producer. These two States and mines in Wisconsin (1,436,233 tons or 2 percent) constitute the Lake Superior region, which supplied 85 percent of the domestic total. The ratio of open-pit to underground production remained about the same in 1941; approximately two-thirds of the output in both years came from open-pit operations.

Iron ore mined in the United States in 1941, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Number of active mines	Hematite	Brown ore	Magnetite	Carbonate	Total
Alabama	[1] 76	6,791,237	1,093,614			7,884,851
California	3	[2] 51,644		[2] 1,887		53,531
Connecticut	1		88			88
Georgia	[1] 19	21,313	239,354			260,667
Michigan	41	14,671,192				14,671,192
Minnesota	102	62,750,860	47			62,750,907
Mississippi	1		51			51
Missouri	[1] 6	7,884	10,769			18,653
Nevada	1	215				215
New Jersey	4			649,374		649,374
New York	5	8,553		3,300,451	606	3,312,610
Pennsylvania	3		3,000			
Oklahoma	2		208			208
South Dakota	1					
Virginia	1		19,718			19,718
Texas	1					
Utah	2			355,006		355,006
Washington	3	423		10,000		10,423
Wisconsin	3	1,436,233				1,436,233
Wyoming	1	985,852				985,852
Total: 1941	[1] 276	[2] 86,725,406	1,366,849	[3] 4,316,718	606	92,409,579
1940	[1] 230	[3] 68,869,837	[4] 934,625	[3,4] 3,890,924	513	73,695,899

[1] Excludes an undetermined number of small pits. Output of these pits included in tonnage given.
[2] Small quantity of magnetite included with hematite.
[3] Small quantity hematite included with magnetite.
[4] Small quantity of brown ore included with magnetite.

[2] This figure does not include an undetermined number of small mines whose aggregate output is only a fraction of 1 percent of the total.

Shipments of iron ore likewise were much larger in 1941, amounting to 93,053,994 gross tons—an increase of 24 percent over 1940. The greater part of the iron ore mined in the United States is employed in the manufacture of iron and steel, but 99,480 tons of domestic ore were shipped in 1941 for other uses, as follows: Cement, 57,133 tons; paint, 20,792 tons; ferromagnesite, 6,000 tons; flux at nonferrous smelters, 1,795 tons; and other industries, 13,760 tons.

The quantities of iron ore in the following tables include ore that was beneficiated—that is, treated in any way to improve the ore content—as well as ore that did not require treatment.

Although included in the figures on production, the iron ore sold for the manufacture of paint—20,792 tons in 1941 valued at $101,710 ($4.89 a ton) compared with 8,912 tons in 1940 valued at $45,578 ($5.11 a ton)—is not included in shipments from mines. The output of manganiferous ore that contained 5 to 35 percent manganese also is excluded. Moreover, the statistics do not include iron sinter recovered from the roasting of domestic pyrite concentrates in Tennessee.

Quantity and tenor of iron ore mined in the United States, 1940–41, by States and mining methods

State	1940				1941			
	Open pit (gross tons)	Underground (gross tons)	Total: Gross tons	Total: Iron content, natural (percent)	Open pit (gross tons)	Underground (gross tons)	Total: Gross tons	Total: Iron content, natural (percent)
Alabama	837,488	6,478,639	7,316,127	36.43	1,195,148	6,689,703	7,884,851	37.15
California	1,071		1,071	63.03	53,531		53,531	55.25
Connecticut					88		88	45.00
Georgia	100,641	645	101,286	47.14	259,217	1,450	260,667	46.91
Michigan	1,505,812	10,966,636	12,472,448	52.03	1,706,375	12,964,817	14,671,192	51.68
Minnesota	43,560,321	4,176,489	47,736,810	52.36	58,255,854	4,495,053	62,750,907	52.43
Mississippi	50		50	40.90	51		51	45.80
Missouri	53,238	400	53,638	51.66	17,369	1,284	18,653	51.90
Nevada					215		215	45.00
New Jersey		659,425	659,425	62.35		649,374	649,374	62.35
New York	[1] 2,900,499	([1])	2,900,499	66.56	[1] 3,312,610	([1])	3,312,610	66.92
Pennsylvania				39.73				39.64
Tennessee	23,187		23,187	47.24				
Virginia				54.32				53.60
South Dakota	640		640	[2] 51.03	19,718		19,718	46.00
Texas	5,453		5,453	51.50				52.50
Oklahoma				45.02	208		208	47.10
Utah	326,500		326,500	54.97	355,006		355,006	54.47
Washington	3,942	1,444	5,386	65.00	10,000	423	10,423	66.30
Wisconsin		1,262,065	1,262,065	53.35	4,000	1,432,233	1,436,233	53.32
Wyoming	272,467	558,847	831,314	[2] 51.03	2,847	983,005	985,852	51.36
	[1] 49,591,309	[1] 24,104,590	73,695,899	50.64	[1] 65,192,237	[1] 27,217,342	92,409,579	50.93

[1] Some underground included with open pit.
[2] Average percentage for South Dakota and Wyoming.

Iron ore mined in the United States, by mining districts and varieties, in 1941, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
Lake Superior [1]	78,858,285				78,858,285
Birmingham	6,787,077	415,187			7,202,264
Chattanooga	25,473	421,756			447,229
Adirondack and Cornwall			3,300,451		3,300,451
Northern New Jersey			649,374		649,374
Other districts	[2] 1,054,571	529,906	[2] 366,893	606	1,951,976
	[2] 86,725,406	1,366,849	[2] 4,316,718	606	92,409,579

[1] Includes only those mines in Minnesota that are in the true Lake Superior district
[2] Small quantity of magnetite included with hematite.

Iron ore shipped from mines in the United States, 1940–41, by States

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

State	1940		1941	
	Gross tons	Value	Gross tons	Value
Alabama	7,330,412	$12,606,369	7,873,228	$18,090,992
California	1,071	(1)	53,531	(1)
Connecticut			28	(1)
Georgia	100,342	182,613	258,947	598,497
Michigan	13,751,970	40,474,951	15,201,619	43,765,164
Minnesota	47,904,137	118,947,968	62,874,891	167,781,967
Mississippi	50	38	51	101
Missouri	50,217	123,234	13,410	35,543
Nevada			215	645
New Jersey	693,998	3,328,467	666,550	3,437,082
New York, Pennsylvania	2,942,948	8,172,955	3,265,912	9,678,564
Tennessee, Virginia	23,038	(1)	11,278 (Tennessee, Virginia, Texas, Oklahoma)	(1)
Texas, Oklahoma	8,665	(1)		
Utah	326,500	(1)	355,006	(1)
Washington	5,582	(1)	6,492	(1)
Wisconsin	1,227,840	3,290,389	1,486,776	3,998,287
Wyoming	831,314	(1)	985,852	(1)
Undistributed		[2] 1,959,815		[2] 2,319,061
	75,198,084	189,086,799	93,053,994	249,705,903

[1] Included under "Undistributed."
[2] Includes value for States entered as "(1)."

PRINCIPAL MINES

The importance of large operations in the iron-mining industry is shown by the fact that 18 units yielding more than 1,000,000 tons each produced 56 percent of the entire output in 1941. Of the 18 million-ton producers in 1941, 13 are in Minnesota (all on the Mesabi range), 2 in Alabama, 1 each in Pennsylvania and Wisconsin, and 1 in Michigan. Of the 18 principal producers in 1941, 11 were open-pit operations, 4 were operated by underground methods, and 3 were combinations. Except for 1 mine that produced magnetite, all the principal mines produced hematite.

Iron-ore mines of the United States in 1941, by size of output

Name of mine	State	Nearest town	Range or district	Mining method	Gross tons
Hull-Rust-Burt-Sellers group	Minnesota	Hibbing	Mesabi	Open pit	16,771,069
Missabe Mountain	do	Virginia	do	do	4,603,064
Red Mountain group	Alabama	Bessemer	Birmingham	Underground	4,056,217
Mahoning	Minnesota	Hibbing	Mesabi	Open pit	4,040,388
Hill Annex	do	Calumet	do	do	3,645,950
Adams-Spruce group	do	Eveleth	do	Combined	3,452,366
Morris	do	Hibbing	do	do	1,715,001
Frazer	do	Chisholm	do	Open pit	1,398,785
Hill-Trumbull	do	Marble	do	do	1,285,681
Woodward No. 3	Alabama	Bessemer	Birmingham	Underground	1,084,915
Montreal	Wisconsin	Montreal	Gogebic	do	1,080,136
Morrison	Minnesota	Coleraine	Mesabi	Open pit	1,077,687
Negaunee	Michigan	Negaunee	Marquette	Underground	1,041,953
Arcturus	Minnesota	Marble	Mesabi	Open pit	1,037,912
Kevin	do	Nashwauk	do	do	1,036,225
Scranton	do	Hibbing	do	do	1,025,323
Biwabik	do	Biwabik	do	do	1,012,757
Sunrise	Wyoming	Sunrise	Hartville	Combined	985,852
Penn group	Michigan	Vulcan	Menominee	Underground	914,359
Susquehanna	Minnesota	Hibbing	Mesabi	Open pit	876,787
Bennett	do	Keewatin	do	Combined	875,366
Maas	Michigan	Negaunee	Marquette	Underground	855,037
Holman-Brown	Minnesota	Taconite	Mesabi	Open pit	850,900
Minnewas	do	Virginia	do	do	817,320
Albany	do	Hibbing	do	do	807,949
Raimund Nos 1 and 2.	Alabama	Bessemer	Birmingham	Underground	723,501
Zenith	Minnesota	Ely	Vermilion	do	721,744
Danube	do	Coleraine	Mesabi	Open pit	708,876
Corsica	do	Elcor	do	do	706,478
Anvil-Palms-Keweenaw	Michigan	Bessemer	Gogebic	Underground	695,935
Cliffs Shaft	do	Ishpeming	Marquette	do	672,621
Athens	do	Negaunee	do	do	658,912
Eureka	do	Ramsay	Gogebic	do	612,502
Plymouth	do	Wakefield	do	Open pit	607,169
Penokee	do	Ironwood	do	Underground	602,272
Newport	do	do	do	do	597,119
Godfrey	Minnesota	Chisholm	Mesabi	do	589,135
Canisteo	do	Coleraine	do	Open pit	585,679
Grant	do	Buhl	do	do	581,691
Sunday Lake	Michigan	Wakefield	Gogebic	Underground	574,741
Lloyd	do	Ishpeming	Marquette	do	558,253
Sloss Nos 1 and 2	Alabama	Bessemer	Birmingham	do	552,050
Davis-Geneva-West Davis.	Michigan	Ironwood	Gogebic	do	544,710
Pioneer	Minnesota	Ely	Vermilion	do	527,724
Hiawatha Nos 1 and 2.	Michigan	Stambaugh	Menominee	do	520,386
Harrison	Minnesota	Cooley	Mesabi	Open pit	506,163
Harmony and Old Bed	New York	Mineville	Adirondack	Underground	3,300,451
Cornwall	Pennsylvania	Miners Village	Cornwall	Combined	
Chateaugay	New York	Lyon Mtn	Adirondack	Underground	
Output of 48 [1] mines producing more than 500,000 tons each					[1] 72,497,111
Output of 5 mines producing between 400,000 and 500,000 tons each					2,185,267
Output of 18 [1] mines producing between 300,000 and 400,000 tons each					[1] 5,966,491
Output of 19 mines producing between 200,000 and 300,000 tons each					4,702,289
Output of 30 mines producing between 100,000 and 200,000 tons each					4,546,423
Output of 19 mines producing between 50,000 and 100,000 tons each					1,336,780
Output of 137 mines producing less than 50,000 tons each					1,175,218
Grand total of United States (276 [2] mines)					92,409,579

[1] 1 mine producing between 300,000 and 400,000 tons included with those producing more than 500,000 tons.

[2] Excludes an undetermined number of small pits The output of these pits is included in the tonnage given

BENEFICIATION

Beneficiation of iron ore was reported at 112 mines in 8 States in 1941 compared with 70 mines in 8 States in 1940. At many mines the ore is crushed and screened to improve its structure, but ore so improved is not included in the statistics on beneficiated ore. Some iron ore is recovered as dust from blast furnaces; data on ore so re-

covered, however, have been accounted for previously in shipments from mines.

Beneficiated ore shipped from domestic mines in 1941 increased 50 percent over 1940 and comprised 21 percent of the total shipments compared with 17 percent in 1940.

Beneficiated iron ore shipped from mines in the United States, 1940–41

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Variety	1940		1941	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	750,131	$1,792,584	1,230,892	$3,273,354
Georgia	do	41,015	63,353	245,972	572,361
Minnesota	Hematite	9,353,270	23,839,368	14,846,899	38,483,473
New Jersey	Magnetite	604,249	2,817,541	666,550	3,437,082
New York Pennsylvania	do do	2,149,197	8,569,580	2,375,123	10,017,684
Tennessee Texas	Brown ore do	27,879	91,164		
California	Magnetite			10,684	50,940
		12,925,741	37,173,590	19,376,120	55,834,894

The quantity of crude ore beneficiated in the Lake Superior district (all in Minnesota) in 1941 totaled 25,691,501 gross tons and the beneficiated ore recovered 15,125,368 tons—a ratio of 1.699 : 1. In 1940 the crude ore treated totaled 14,547,504 tons and the beneficiated ore recovered therefrom 9,439,921 tons—a ratio of 1.541 : 1. Most of the concentration in this district is done by washing, but a few plants are equipped with jigs, and two plants sinter ore after washing. Processes have been described by Counselman.[4]

In the past, an increase in domestic iron-ore production has been accompanied by a percentage decrease in the quantity of beneficiated ore shipped. However, in the record year 1941, 21 percent of the shipments were beneficiated ore compared with 17 percent in 1940. Thus it is apparent that supplies of direct shipping ores are being stressed to the limit, and lower-grade deposits are being exploited. This is made possible in part by more efficient mining and beneficiating methods. Data showing the relationship between beneficiated ore and total shipments for recent years are shown in the following table, and corresponding statistics for 1914 (the first year for which they were gathered) to 1929 are given in Mineral Resources, 1930, part 1. Data for 1930 to 1934, inclusive, are given in Minerals Yearbook, 1935, and for 1932 to 1936, inclusive, in Minerals Yearbook, 1937.

Iron ore shipped from mines in the United States, 1925–29 (average) and 1937–41, in gross tons, and percentage of beneficiated ore compared to the total shipped

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

Year	Beneficiated	Total	Proportion of beneficiated to total (percent)	Year	Beneficiated	Total	Proportion of beneficiated to total (percent)
1925–29 (av.)	8,653,590	66,697,126	13 0	1939	9,425,809	54,827,100	17 2
1937	12,350,136	72,347,785	17 1	1940	12,925,741	75,198,084	17.2
1938	4,836,435	26,430,910	18 3	1941	19,376,120	93,053,994	20 8

[4] Counselman, T. B., Beneficiating Minnesota Iron Ores. Regional Meeting, Am Inst Min. and Met. Eng., Duluth, August 12–15, 1941, pp. 15–22.

AVERAGE VALUE

The average value per gross ton of iron ore at the mines was $2.68 in 1941 compared with $2.51 in 1940.

The table that follows gives the average value at the mines of the different classes of iron ore in 1940–41 for each of the producing States or groups of States, except where there are fewer than three shippers of a certain variety of ore in a State and permission was not given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately, as not all reports are comparable. Some evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others comprise only costs charged against blast furnaces. None of the reports, however, is supposed to include freight charges.

Average value per gross ton of iron ore at mines in the United States, 1940–41

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1940	1941	1940	1941	1940	1941
Alabama	$1.65	$2.26	$2.33	$2.50		
Georgia	2.24	2.61	1.79	2.29		
Michigan	2.94	2.88				
Minnesota	2.48	2.67				
Missouri	2.32	2.40	2.50	2.94		
New Jersey					$4.80	$5.16
New York		(1)			2.78	2.96
Pennsylvania						
Wisconsin	2.68	2.69				
Other States [2]	1.11	1.19	3.13	4.82	2.82	2.83
	2.48	2.66	2.31	2.49	3.13	3.43

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.

[2] 1940: California, Mississippi, Oklahoma, Tennessee, Texas, Utah, Virginia, Washington, and Wyoming; 1941 California, Connecticut, Mississippi, Nevada, Oklahoma, Texas, Utah, Virginia, Washington, and Wyoming

CONSUMPTION

The production of 55,085,446 net tons of pig iron in 1941 required 94,404,667 net tons of iron ore and manganiferous iron ores, 6,858,576 tons of mill cinder and roll scale, and 1,317,072 tons of purchased scrap, an average of 1.862 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of iron made.

The greater part of the iron ore used in Alabama furnaces in 1941 was hematite, chiefly from mines in Jefferson County, but some hematite came from De Kalb, Cherokee, and St. Clair Counties. Brown ore, iron sinter, pyrite ash, imported iron ore, manganese ore, and small quantities of domestic manganese-bearing ores were used. The brown ore originated chiefly in mines of the Birmingham and Russellville districts, Alabama, and the Chattanooga district, Georgia. In addition to iron sinter (sintered pyrite ash) from Tennessee, pyrite ash was shipped to Birmingham in 1940 from acid plants in other Southern States. The pyrite from which this ash was made came from both domestic and foreign ores. The domestic manganese-bearing ores came chiefly from Arkansas, Georgia, and Tennessee. Imported

manganese-bearing ores came from Cuba. In 1941, Alabama furnaces consumed an average of 2.450 tons of ore in making 1 ton of pig iron—the highest average for any State.

Maryland furnaces consumed considerable domestic ore in 1941, in addition to ores from Africa, Brazil, Chile, and Cuba. These furnaces used an average of 1.597 tons of ore per ton of pig iron; however, they used proportionately more cinder, scale, and scrap than any other State.

Blast furnaces in Illinois, Indiana, Kentucky, Michigan, Minnesota, and West Virginia handled Lake Superior iron ore and manganiferous iron ore almost exclusively. Furnaces in Kentucky had the lowest consumption of metal-bearing material per ton of iron.

In New York the furnaces in the Buffalo district used ore chiefly from the Lake Superior district, magnetite from New York, and some manganese ore from Cuba, and the furnace at Troy consumed magnetite from the Chateaugay mine at Lyon Mountain, N. Y.

Blast furnaces in Ohio consumed magnetite from New York and hematite and brown ore from Missouri, in addition to ore from the Lake Superior district.

Virtually all the ore consumed in western Pennsylvania furnaces came from the Lake Superior district. Those in the eastern part of the State used some Lake ore; magnetite ores from Pennsylvania, New Jersey, and New York; and some ore from Africa, Australia, Chile, Cuba, and Spain.

The Pueblo (Colo.) blast furnaces consumed hematite from the Sunrise mine in Wyoming and manganese-bearing ores, chiefly from Colorado, New Mexico, and California.

The Provo (Utah) furnace treated chiefly semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, manganese tailings from Montana, and manganese-bearing ores from Nevada, Idaho, and Utah.

The Tennessee furnace used chiefly Tennessee brown ore and iron sinter.

Iron ore and other metallic materials consumed and pig iron produced in 1941, by States, in net tons

State	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made		
	Iron and manganiferous iron ores		Cinder, scale, and purchased scrap	Total		Ores	Cinder, scale, and purchased scrap	Total
	Domestic	Foreign						
Alabama	8, 852, 045	6, 228	197, 841	9, 056, 114	3, 696, 566	2 396	0 054	2 450
Illinois	9, 421, 151		573, 976	9, 995, 127	5, 354, 767	1 760	107	1 867
Indiana	11, 101, 430		815, 607	11, 917, 037	6, 374, 331	1 742	128	1 870
Kentucky	517, 500		44, 329	561, 829	328, 912	1. 573	. 135	1 708
Maryland	1. 705, 179	2, 052, 021	528, 433	4, 285, 633	2, 353, 203	1 597	224	1 821
Michigan	2, 167, 722	89, 948	109, 171	2, 366, 841	1, 350, 450	1 672	. 081	1 753
Minnesota	618, 656		74, 844	693, 500	359, 263	1 722	. 208	1 930
New York	6, 006, 912	76, 025	412, 537	6, 495, 474	3, 574, 901	1 702	115	1 817
Ohio	20, 753, 800		2, 124, 844	22, 878, 644	12, 787, 243	1 623	166	1 789
Pennsylvania	27, 433, 619	125, 858	3, 090, 630	30, 650, 107	16, 856, 917	1 635	183	1 818
West Virginia	1, 629, 573		146, 843	1, 776, 416	1, 019, 150	1 599	144	1 743
Undistributed[1]	1, 808, 470	38, 530	56, 593	1, 903, 593	1, 029, 743	1 794	055	1 849
	92, 016, 057	2, 388, 610	8, 175, 648	102, 580, 315	55, 085, 446	1 714	. 148	1 862

[1] Includes Colorado, Iowa, Massachusetts, Tennessee, and Utah.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1940–41, by sources of ore, in net tons

Source of ore	1940	1941	Source of ore	1940	1941
Africa	18,261	14,775	Norway	4,591	
Australia	13,755	2,265	Palestine	16,509	554
Brazil	15,912	17,883	Spain	3,567	9,496
Canada	101,165	202,809	Sweden	586	
Chile	1,920,525	1,907,980	U. S. S. R.	151	
Cuba	324,643	232,848			
Newfoundland	18,450			2,443,115	2,388,610

STOCKS AT MINES

Stocks at mines varied considerably in some States, but the United States total decreased only 1 percent from December 31, 1940, to December 31, 1941.

Stocks of iron ore at mines, December 31, 1940–41, by States, in gross tons

State	1940	1941	State	1940	1941
Alabama	15,485	28,693	Pennsylvania	52,753	81,012
Connecticut		60	Texas	638	6,860
Michigan	2,302,980	1,939,457	Utah		500
Minnesota	952,813	1,310,487	Virginia	3,086	3,086
Missouri	2,375	2,491	Washington	69	
New Jersey	65,550	1,572	Wisconsin	197,673	190,292
New York	20,120	27,631			
North Carolina	200			3,613,742	3,592,141

FOREIGN TRADE

Imports for consumption of iron ore for only the first 9 months of 1941 are available for publication. During that period, Chile was the chief source of iron ore imported into this country, furnishing 73 percent of the total; Canada supplied 12, Cuba 8, and Brazil 5 percent. In addition to the figures in the following table, 22,439 tons of dross or pyrite ash were imported from Canada during the first 9 months of 1941.

Iron ore imported for consumption in the United States, 1939–41, by countries, in gross tons

Country	1939		1940		1941 (Jan.-Sept.)	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	7,000	$25,167				
Australia	16,520	30,184				
Brazil	16,700	68,267	99,165	$460,669	80,320	$309,984
British West Africa ("Other")	11,540	55,677	7,190	32,775		
Canada	23,275	129,251	217,938	1,050,051	201,152	911,098
Chile	1,586,625	2,824,252	1,682,600	3,028,699	1,251,280	2,280,485
Cuba	269,866	596,318	219,653	436,515	135,638	270,144
Iran (Persia)	110	5,207	3,650	85,733		
Mexico	1,722	3,319	3,590	7,206	3,602	7,587
Newfoundland and Labrador	14,450	41,183	23,320	63,698	28,291	77,122
Norway	199,966	845,355				
Philippine Islands	22	230				
Spain			11,010	55,793	7,292	50,755
Sweden	264,353	1,227,864	210,804	968,925		
United Kingdom	356	13,214	393	14,290	236	10,277
Yugoslavia			10	160		
Other countries	10	22	3	127		
	2,412,515	5,865,510	2,479,326	6,204,641	1,707,811	3,917,452

Exports of iron ore from the United States totaled 1,347,641 gross tons valued at $4,362,806 ($3.24 a ton) during the first 9 months of 1941. Exports for the full year 1940 totaled 1,386,304 gross tons valued at $4,624,555 ($3,34 a ton).

MINING IN CUBA

Shipments from Cuban mines decreased 5 percent in 1941 from 1940. The 1941 total (200,350 gross tons) included 73,308 tons of hematite carrying (dried) 56.17 percent iron, and 84,396 tons of siliceous ore carrying (dried) 30.34 percent iron, from the Daiquiri-Juragua mines on the southern coast, and 42,646 tons of nodulized brown ore carrying (dried) 55.69 percent iron from the Mayari district near the northern coast. The Mayari mine resumed operations in 1941.

The total stock of ore reported on hand was 90,930 gross tons at the end of the year compared with 111,797 tons at the end of 1940.

The following table shows shipments of iron ore from Cuba since the mines were opened in 1884. The statistics on shipments of Cuban iron ore are collected by the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1941, in gross tons

Year	Juragua (hematite and magnetite), Daiquiri (hematite and a little magnetite)	Sigua (hematite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1939	[1]22, 162, 124	20, 438	3, 901, 183	41, 241	903, 103	27, 028, 089
1940	177, 044		33, 024			210, 068
1941	157, 704		42, 646			200, 350
	22, 496, 872	20, 438	3, 976, 853	41, 241	903, 103	27, 438, 507

[1] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia, and 64,228 tons to other ports outside of the United States.

REVIEW OF LAKE SUPERIOR DISTRICT

Production and shipments.—Operations in the Lake Superior district (the principal producing district) were conducted at record levels during 1941. The Lake shipments broke many records during 1941 and moved 79,654,785 gross tons of iron ore and manganese-bearing ore from United States ports. The season had the earliest opening (April 8) in 40 years, and 6,918,914 tons were shipped during April compared with 464,669 in April 1940. The quantity shipped increased every month to August, when record shipments of 11,429,569 gross tons were made. Likewise, a favorable late closing date (December 8) permitted shipments of 822,998 tons in December.

Eighty-five percent of the United States total iron-ore production came from the Lake Superior district in 1941, and all shipping facilities were strained to the limit. In July Canadian vessels entered the American ore trade to assist in shipping the year's record tonnage. Total shipments of ore by water and all-rail from the Lake Superior district were 80,748,454 gross tons (79,563,286 tons of iron ore and 1,185,168 tons of manganese-bearing ores containing 5 percent or

more manganese) compared with 63,949,536 tons (62,884,545 tons of iron ore and 1,064,991 tons of manganese-bearing ore containing 5 percent or more manganese) in 1940. The iron-ore-shipment figures given above include 47 tons of iron ore from Fillmore County, Minn., which is outside the true Lake Superior district.

Production in the Lake Superior region in 1941 increased 28 percent over 1940, to establish an all-time record. The 85 percent of the United States total contributed by the district in 1941 compares with 83 percent in 1940 and 81 percent in 1939. It is therefore apparent that as domestic iron-ore-mining activity increases, the bulk of the increase is supplied from the Lake Superior region. Several ranges contributed to the district total. The Mesabi was the largest producer, furnishing 76 percent of the district and 65 percent of the United States total. The output, by ranges, is listed in the following table. After 1905 figures do not include manganiferous iron ore containing 5 percent or more manganese.

Iron ore mined in the Lake Superior district, 1854–1941, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1939	201,533,822	184,770,564	213,782,729	67,135,407	1,073,242,695	26,056,086	1,766,521,303
1940	5,284,194	2,679,364	5,770,357	1,531,963	45,483,450	721,397	61,470,725
1941	6,230,612	3,822,451	6,054,362	1,853,030	59,688,047	1,209,783	78,858,285
	213,048,628	191,272,379	225,607,448	70,520,400	1,178,414,192	27,987,266	1,906,850,313

In 1941, 76 percent of the ores produced on the iron ranges of the Lake Superior district came from open-pit mines. A large part of the open-pit production originates in the Mesabi range, which in 1941 supplied 96 percent of the open-pit ore mined in the district. There is no open-pit mining in northern Wisconsin and relatively little in Michigan. In addition to the output on the Mesabi range, there is some open-pit production in Minnesota on the Cuyuna and Vermilion ranges.

Holt [5] has described the progress made in the mining industry of Minnesota during the last few years. Open pits, which were not feasible in the past, are now being developed, because of the rapid improvement in stripping and mining methods. The work formerly required in constructing railroad tracks, building, and dump trestles has been eliminated in favor of the speedy and efficient method of using trucks and bulldozers for stripping and hauling.

Most stripping is done in winter in order to spread out labor requirements over the entire year and to utilize equipment that otherwise would be idle. The newer equipment now available is built for work in extreme cold and heat. Overburden is loaded by electric, Diesel, or gasoline shovels and a few steam shovels. The larger pits still use locomotives and side-dump stripping cars, but truck haulage is replacing steam locomotives to a greater extent each year. After the overburden has been removed, virtually all ores require drilling and blasting before loading. Most drilling is done with a churn-type drill,

[5] Holt, Grover J., Mining Practice and Mine Transportation on Minnesota's Iron Ranges: Regional Meeting, Am. Inst. Min. and Met. Eng., Duluth, Minn., August 12–15, 1941, pp. 10–14.

although recently a new type of large-diameter auger has been used successfully for drilling horizontal holes.

The most important development in mining in recent years has been the radical change in the methods of transporting open-pit ore. In many pits the change to trucks, tractors, bulldozers and belt-conveyor systems has necessitated replacing tracks, locomotive repair shops, and locomotive engineers with roads, garages, drivers, and mechanics. Locomotive cranes are being replaced by cranes mounted on treads and trucks.

Shipments from the Michipicoten range in Ontario, Canada, continued during 1941. Although this output is not included in Bureau of Mines production figures, it enters the same commercial channels. The ore comes from the old Helen mine of the Algoma Steel Corporation, which in August 1939 began to produce from new open-pit operations and made shipments for the first time since 1922. A total of 462,747 tons of sinter, made from the carbonate ores, was shipped during the season, compared with 361,394 tons in 1940.

Analyses.—The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the past 5 years. This uniformity does not mean, of course, that the average grade of available Lake Superior ore is not declining. The grade of shipments has been maintained partly by beneficiation and partly by mixing ores from different deposits. The method of sampling and grading Lake Superior iron ores has been described by Bayer,[6] and the method of classification and sampling by Murray.[7]

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1937–41

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1937	61,972,823	51.53	0.091	8.27	0.82	11.31
1938	19,353,497	51.90	.089	8.25	.81	10.13
1939	44,983,754	51.75	.085	8.27	.76	10.73
1940	63,308,413	52.09	.085	8.00	.77	10.93
1941	79,941,240	51.83	.085	8.18	.78	11.01

Stocks at Lake Erie ports.—At the close of navigation in 1941 according to the Lake Superior Iron Ore Association, 5,290,117 gross tons were in stock at Lake Erie ports compared with 4,786,643 tons on the corresponding date in 1940. At the opening of navigation in May 1942, 2,529,175 tons were in stock at these ports—an increase of 594,106 tons from the figure on May 1, 1941. Withdrawals from docks were therefore 2,760,942 tons during the winter of 1941–42.

Prices of Lake Superior ore.—The prices established April 17, 1941, for the four standard grades of Lake Superior ore were unchanged from a year ago and remained 5 cents a ton lower than the price maintained from 1926 to 1939. Beginning April 17, 1940, the unit

[6] Bayer, E. P., Sampling and Grading Mesabi Iron Ore: Min. and Met., vol. 18, No. 372, December 1937, pp. 547–548. Grading Lake Superior Iron Ores: Eng. and Min. Jour., vol. 139, No. 3, March 1938, pp. 50–51.

[7] Murray, C. B., Classification and Sampling; Lake Superior Iron Ores (chap. 4). Lake Superior Iron Ore Assoc., Cleveland, 1938, pp. 69–72.

prices for base ore of the various grades quoted at Lake Erie ports were as follows: Old-Range Bessemer, 9.223 cents; Mesabi Bessemer, 8.932 cents; Old-Range Nonbessemer, 8.932 cents; and Mesabi Nonbessemer, 8.641 cents, respectively, $4.75, $4.60, $4.60, and $4.45 a gross ton. The base of the four standard grades for 1925–41 is an iron content of 51.5 percent natural. For the bessemer grades, the allowable phosphorus content is 0.045 percent (dry), and for the nonbessemer grades the phosphorus content ranges from 0.045 to 0.18 percent. Ores containing more than 0.18 percent phosphorus are classed as high-phosphorus ores, whereas those containing 18 percent or more silica are classed as siliceous ores.

Reserves.—Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of Tax Commissioners, are shown in the following tables. These estimates reveal decreases from 1940 of 24,796,880 gross tons in Minnesota and 1,315,899 tons in Michigan. Reserves in Wisconsin have been estimated recently at 5,500,000 tons.

Unmined iron-ore reserves in Minnesota, May 1, 1937–41, in gross tons

Range	1937	1938	1939	1940	1941
Mesabi	1,173,108,376	1,150,817,768	1,132,513,348	1,122,593,126	1,097,000,026
Vermilion	13,943,325	14,274,025	13,631,484	13,208,699	14,018,934
Cuyuna	61,922,739	60,690,596	61,902,885	65,026,280	65,012,265
	1,248,974,440	1,225,782,389	1,208,047,717	1,200,828,105	1,176,031,225

Iron-ore reserves in Michigan, January 1, 1938–42, in gross tons

Range	1938	1939	1940	1941	1942
Gogebic	40,706,291	40,456,002	37,160,900	31,603,731	30,073,528
Marquette	49,869,363	52,130,385	49,573,794	48,370,114	48,306,120
Menominee	58,031,692	57,168,510	56,922,733	55,851,786	56,130,084
	148,607,346	149,754,897	143,657,427	135,825,631	134,509,732

MINING BY STATES

Alabama.—Production of iron ore in Alabama during 1941 increased 8 percent over 1940 and established a new record. About 85 percent of the 1941 production came from underground operations compared with 89 percent in 1940, indicating a considerable increase in open-pit production during 1941. Consequently, brown-ore production increased 42 percent in 1941. Hematite, which comprised 86 percent of the State total in 1941, is derived chiefly from underground operations on Red Mountain near Birmingham in Jefferson County, where Raimund Nos. 1 and 2, Red Mountain group (comprising the Muscoda, Wenonah, and Ishkooda groups), Ruffner, Sloss Nos. 1 and 2, Spaulding, and Woodward No. 3 mines were producers. Several smaller mines (open-pit and underground) in Cherokee, De Kalb, St. Clair, and Jefferson Counties contributed to the total output of hematite ore. The hematite produced in 1941 averaged (natural) 35.57 percent iron, 0.15 percent manganese, 0.32 percent phosphorus, and 15.02

percent lime. The Red Mountain group, with 4,056,217 tons, was the third-largest producer in the United States in 1941. Limonite (brown ore) is mined from a number of widely scattered deposits in Alabama, but production is not nearly as large as that of red ore. In 1941, the output of brown ore constituted 14 percent of the Alabama total. Brown ores, however, are higher-grade and usually have been beneficiated, although some operations are rather crude. The brown ore mined in 1941 averaged (natural) 47 percent iron and 0.77 percent manganese. Brown ore is mined from open-cuts and was produced chiefly from the Tecumseh mine in Cherokee County, the Russellville and Parish mines in Franklin County, and the Martaban and Reno mines in Tuscaloosa County.

California.—Production of iron ore in California increased from 1,071 tons in 1940 to 53,531 tons in 1941. Most of the ore was hematite used for cement. The ore mined averaged 55 percent iron during 1941.

Connecticut.—A small quantity of brown iron ore came from the Ore Hill mine in Litchfield County during 1941. This ore was used as a foundry flux and was the first iron ore reported from Connecticut since 1920.

Georgia.—The heavy demand for iron ore in the South enabled production of iron ore in Georgia to continue to increase in 1941. Production consisted of 21,313 tons of hematite and 239,354 tons of brown ore compared with 7,163 tons of hematite and 94,123 tons of brown ore in 1940. Virtually all the brown ore mined during 1941 was beneficiated. The iron ore from Georgia averaged (natural) 46.91 percent iron. The average value at the mines was $2.61 for hematite and $2.29 for brown ore compared with $2.24 and $1.79, respectively, in 1940.

Michigan.—Output from Michigan comes from three ranges—the Marquette, the Menominee, and the Gogebic. All ranges increased their production in 1941, the Menominee showing the largest gain in tonnage. Production in Michigan rose 18 percent in 1941 over 1940 and totaled 14,671,192 gross tons. Of this total, 88 percent came from underground mines; the Negaunee mine—an underground producer on the Marquette range—was the largest producer. The iron content (natural) of the ore mined in Michigan in 1941 averaged 51.68 percent compared with 52.03 percent in 1940. Iron-ore reserves in Michigan at the end of 1941 totaled 134,509,732 gross tons—a decrease of 1,315,899 tons during the year.

A report of the iron-ore mines of Michigan for 1941, published by the Geological Survey Division of the Michigan Department of Conservation,[8] shows that the average number of men employed was 7,553 (6,743 in 1940), the average number of days worked 248 (213 in 1940), the average daily wage $7.60 ($7.48 in 1940), the average yearly earning $1,875.79 ($1,593.82 in 1940), and the average tons of ore mined per man per day 7.15 (5.10 in 1940).

The data in the following table on average per-ton costs of mining ore at underground mines and at siliceous open pits have been abstracted from statistics published in much greater detail by the Geological Survey Division of Michigan.

[8] Eddy, G. E., General Statistics Covering Costs and Production of Michigan Iron Mines. Michigan Dept. of Conservation, Geol. Survey Div., Lansing, 1942, 9 pp.

Average costs, per gross ton, of mining iron ore at underground mines and at siliceous open pits in Michigan in 1941

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Dickinson and Iron	Total	
Cost of mining	$1.5062	$1 7452	$1 4880	$1.5990	$0.4417
Deferred mining cost	.1841	.0604	.1343	.1190	.0373
Taxes	.2360	.2041	1325	.1948	.0422
General overhead	.2055	1928	.1646	.1884	.0918
Transportation	1 8009	1 5072	1 6297	1.6460	1.4929
Marketing	.0686	.0919	.0749	.0797	.0801
Royalty	.3581	.2066	.2213	.2581	.0869
Interest on borrowed money	.0003	0392	.0061	.0179	.0002
Total ore cost	4 3597	4 0474	3.8574	4.1029	2.2731
Lake Erie value per ton	4.7429	4 7400	4.4522	4.6577	2.3790
Gross ore profit [1]	.3832	.6926	.5948	.5548	.1059

[1] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

Minnesota.—In 1941, the output of iron ore in Minnesota increased 31 percent over that in 1940 and was 30 percent greater than the previous peak established in 1937. Three ranges contribute to Minnesota's production—the Cuyuna, the Mesabi, and the Vermilion. The Mesabi range supplied a large part of the Minnesota total and in 1941 produced 59,688,047 tons. The output from open-pit mines in 1941 furnished 93 percent of the total compared with 91 percent in 1940 and 88 percent in 1939. Of the 18 domestic mines producing more than 1 million tons each in 1941, 13 were in Minnesota; of these 11 were open pits, and 2 used combination open-pit and underground methods. Of the 102 mines in Minnesota active in 1941 (79 in 1940), 67 (52 in 1940) yielded more than 100,000 tons each. The iron content (natural) of the ore mined in 1941 averaged 52.43 percent compared with 52.36 percent in 1940.

According to the annual report of the mine inspector of St. Louis County, the average number of men employed in iron mines in the county was 7,097 in 1941 (5,547 in 1940), and the average daily wage was $7.02 ($6.70 in 1940) for 8 hours. In 1941, 8,065,960 cubic yards of overburden were removed compared with 2,728,306 in 1940.

According to the annual report of the mine inspector of Itasca County, the average number of men employed in iron mines in the county was 3,947 in 1941 (3,047 in 1940), and the average daily wage was $6.82 ($6.40 in 1940) for 8 hours. In 1941, 11,194,181 cubic yards of overburden were removed compared with 4,395,650 in 1940.

Unmined iron-ore reserves in Minnesota on May 1, 1941, totaled 1,176,031,225 gross tons, a decrease of 24,796,880 tons from 1940.

Missouri.—An undetermined number of small mines and pits in Bollinger, Butler, Carter, Crawford, Dent, Franklin, Madison, St. Francois, Washington, and Wayne Counties supplied the iron-ore output of Missouri in 1941, which decreased considerably from 53,638 tons in 1940 to 18,653 tons in 1941. The ore, which averaged 51.90 percent iron, comprised both hematite and brown ore, was mined by open-pit and underground methods, and was shipped to paint and steel plants as well as to nonferrous smelters.

Nevada.—Jay Jacobson produced the State total of 215 long tons from the Tom O'Shanter mine in Clark county. All was used as a flux in nonferrous smelters.

New Jersey.—The output of iron ore in New Jersey decreased 2 percent in 1941 from 1940 and totaled 649,374 tons. The ore, all magnetite and all from underground operations, came from three mines in Morris County and one mine in Warren County in the northern part of the State. New Jersey ores are crushed and concentrated before shipment. Most of the concentration is done magnetically, although some nonmagnetic martite is recovered by gravity methods, and some hand-sorting is practiced, principally to recover high-grade lump used in open-hearth steel furnaces. The concentrates produced in 1941 averaged (natural) 62.35 percent iron. The largest output came from the Scrub Oaks mine, which produced 798,751 gross tons of crude ore. Concentrates from this ore totaled 317,205 gross tons averaging 62.12 percent iron. Other producers were the Mount Hope, Richard, and Washington mines.

New York.—The iron ore produced in New York during 1941 was chiefly magnetite from underground operations at the Harmony and Old Bed shafts in Essex County and the Chateaugay mine in Clinton County. Some hematite was mined for paint in Oneida and Wayne Counties and a small amount for other coloring purposes in St. Lawrence County. Shipments from New York in 1941 included sinter, averaging 67 percent iron; lump, averaging 61 percent iron; and concentrates, averaging 68 percent iron.

The largest producer was the Republic Steel Corporation, which operates properties at Mineville (near Port Henry) and at Lyon Mountain.

Oklahoma.—The iron ore accredited to Oklahoma in 1941 came from two operations in Johnston County. All was brown ore and was used in the manufacture of cement.

Pennsylvania.—Pennsylvania is the most important source of magnetite in the United States. The output comes from the Cornwall mine in Lebanon County, where the ore is extracted by both open-pit and underground methods. The ore is shipped to Lebanon, Pa.. where it is concentrated magnetically. In addition, some carbonate ore for use in paint was mined in Carbon County in 1941, and some brown paint ore came from Clearfield County. Hickok [9] has summarized the history of iron-ore production in Pennsylvania and the changing economic conditions that affect the industry and control its history; he also discussed the geological environment, mode of origin, and future reserves of the various types of iron ore.

South Dakota.—Iron ore from South Dakota increased from 640 tons in 1940 to 2,150 tons in 1941. All was shipped for paint and was brown ore from the Hausle mine in Pennington County.

Tennessee.—No iron-ore production was reported from Tennessee in 1941. However, a considerable quantity of sintered pyrite ash was made at the plants of the Tennessee Copper Co. in Ducktown Basin. This sinter, which contained 67.5 to 69.4 percent iron and 0.005 percent phosphorus in 1941, moved largely to blast furnaces in Alabama and Tennessee. Such sinter is not included in iron-ore production or shipment figures for the United States.

Texas.—The output of iron ore from Texas came from the Linden mine in Cass County. The product is brown ore, which averaged 52.5 percent iron in 1941.

[9] Hickok, W. O., IV, Iron Ores of Pennsylvania Pennsylvania Geol. Survey Bull. M 18-B, 4th ser., 1939, 21 pp.

Utah.—Two operators in Iron County supplied the Utah total in 1941. By far the larger output came from the Iron Mountain mine, and a relatively small quantity came from the Great Western. The ore, principally semialtered magnetite, contained (natural) 54.47 percent iron and moved largely to the blast furnace at Provo, Utah, although small quantities went to steel plants.

Virginia.—A small production of 331 tons of brown ore came from the Oriskany mine in Botetourt County in 1941 and was shipped for the manufacture of hydrogen gas.

Washington.—Two underground mines, the Napoleon in Stevens County and the Keystone in Pend Oreille County, and an open-pit mine, the Neutral in Okanogan County, supplied the iron ore from Washington in 1941. The underground mines yielded hematite averaging about 27 percent iron, which was used in the manufacture of cement. The Neutral mine yielded magnetite averaging about 68 percent iron, which was used in making ferromagnesite.

Wisconsin.—The Montreal underground mine in Iron County was the largest producer of iron ore in Wisconsin, contributing 1,080,136 gross tons of the 1,436,233 produced in 1941. The ore—hematite—averaged (natural) 53.32 percent iron, 1.12 percent manganese, and 0.052 percent phosphorus. The Cary underground mine, also in Iron County, furnished 352,097 tons of hematite containing (natural) 53.21 percent iron, 1.26 percent manganese, and 0.054 percent phosphorus. In addition, 4,000 tons of ore were shipped from the Matilda mine in Florence County.

Wyoming.—The output of iron ore from Wyoming in 1941, all from the Sunrise mine, was 985,852 gross tons of hematite containing (dry) 55.11 percent iron, 0.08 percent manganese, 0.075 percent phosphorus, and 6.8 percent moisture. Much of the ore is a red, earthy hematite similar to Mesabi ore. Production came from both open-pit and underground operations.

Iron ore mined in the United States, 1940–41, by States and counties

[Exclusive of ore containing 5 percent or more manganese]

State and county	1940 Active mines	1940 Gross tons	1941 Active mines	1941 Gross tons
Alabama				
Blount	3	30,016	[1] 2	32,395
Butler	} 3	} 25,765	9	40,325
Crenshaw			1	8,176
Calhoun	[1] 4	22,557	[1] 5	8,630
Cherokee	[1] 10	54,411	[1] 11	89,008
Chilton	2	5,982	2	2,801
Cleburne	1	24,790	1	33,615
Colbert	1	48	1	220
DeKalb	---	---	4	1,411
Etowah	1	2,249	1	190
Franklin	[1] 3	235,120	[1] 12	423,061
Jefferson	11	6,541,407	9	6,787,018
Lamar	[1] 1	317	---	---
Marshall	1	609	1	157
Pike	2	15,720	2	8,151
St. Clair	---	---	1	59
Shelby	1	137	1	48
Talladega	[1] 3	44,348	[1] 6	53,551
Tuscaloosa	4	312,651	4	379,943
Unknown	---	---	[1] 3	16,092
	[1] 51	7,316,127	[1] 76	7,884,851
California:				
San Bernardino	} 2	} 1,071	1	} 53,531
Inyo			1	
Santa Cruz			1	
	2	1,071	3	53,531
Connecticut				
Litchfield	---	---	1	88

[1] In addition there is an undetermined number of small pits. The output of these pits is included in the tonnage given.

Iron ore mined in the United States, 1940–41, by States and counties—Continued

[Exclusive of ore containing 5 percent or more manganese]

State and county	1940 Active mines	1940 Gross tons	1941 Active mines	1941 Gross tons
Georgia				
Bartow	4	27,262	[1]5	83,296
Chattooga	1	84		
Cherokee			[1]1	164
Floyd	1	89	[1]1	417
Gordon			1	143
Polk	[1]4	66,688	[1]8	170,250
Walker	4	7,163	[1]3	6,397
	[1]14	101,286	[1]19	260,667
Michigan				
Dickinson	3	764,395	3	1,018,484
Gogebic	10	4,508,890	9	4,622,129
Iron	13	1,914,969	14	2,799,967
Marquette	14	5,284,194	15	6,230,612
	40	12,472,448	41	14,671,192
Minnesota				
Crow Wing	8	721,397	8	1,209,783
Itasca	29	10,570,746	33	16,103,012
St Louis	42	36,444,667	59	45,433,964
Fillmore			1	47
Lake			1	4,101
	79	47,736,810	102	62,750,907
Mississippi				
Marshall	1	50		
Prentiss			1	51
Missouri				
Butler, Carter, Crawford, and Wayne; Phelps	[1]5	43,890	[1]2	16,761
Bollinger	1	800	(2)	385
Madison	1	320	(2)	
Dent	1	400	1	600
Franklin			1	86
Iron	1	155		
Miller	1	6,683		
St. Francois	1	654	1	180
Texas	1	28		
Washington	2	708	1	641
	[1]14	53,638	[1]6	18,653
Nevada Clark			1	215
New Jersey				
Morris	3	659,425	3	649,374
Warren	1		1	
	4	659,425	4	649,374
New York:				
St Lawrence	1		1	
Essex	1		1	
Clinton	1		1	
Oneida	1	2,899,986	1	3,309,004
Wayne			1	
Pennsylvania				
Lebanon	1		1	
Carbon	1	513	1	606
Clearfield			1	3,000
	6	2,900,499	8	3,312,610
South Dakota. Pennington	1	640	1	2,150
Virginia				
Roanoke	1			
Botetourt	2		1	331
Tennessee		23,187		
Hamilton	1			
Hickman	1			
Lewis	1			
	6	23,187	1	331
Texas Cass	1	5,453	1	17,445
Oklahoma. Johnston	2		2	
	3	5,453	3	17,445
Utah Iron	2	326,500	2	355,006
Washington:				
Okanogan	1	3,592	1	10,423
Pend Oreille	1	1,444	1	
Stevens	1	350	1	
	3	5,386	3	10,423
Wisconsin				
Dodge	1	598		
Iron	2	1,261,467	2	1,432,233
Florence			1	4,000
	3	1,262,065	3	1,436,233
Wyoming Platte	1	831,314	1	985,852
	[1]230	73,695,899	276	92,409,579

[1] In addition there is an undetermined number of small pits The output of these pits is included in the tonnage given

[2] Undetermined number of small pits The output of these pits is included in the tonnage given.

MEN EMPLOYED AND OUTPUT PER MAN

Although complete information on employment at iron-ore mines in 1941 is not yet available, incomplete figures indicate that about 28,000 men working about 56,000,000 man-hours were required to produce 92,409,579 tons of merchantable ore—an average of about 1.7 tons per man-hour, an all-time record. Thus, the total man-hours worked in 1941 advanced 15 percent over 1940, whereas the output of merchantable ore increased 25 percent; in consequence, output per man-hour increased 13 percent. The gain in output per man-hour in

1941 compared with 1940 was due mainly to a further shift in the production of ore from underground to open-pit mines and to nearer-capacity operation of large units. Specifically about 71 percent of the output came from open-pit mines in 1941 compared with 67 percent in 1940, and 18 mines produced more than 1 million tons each in 1941 compared with 15 in 1940.

Figure 3 shows trends in employment and output at iron-ore mines in the United States from 1923 to 1940.

During 1940 (the latest year for which complete statistics are available) a substantial increase in iron-ore output resulted in increased employment at the mines. The average number of men increased, as did the average number of days and total man-hours worked. In 1940, 25,128 men working 48,731,997 man-hours produced 73,695,899

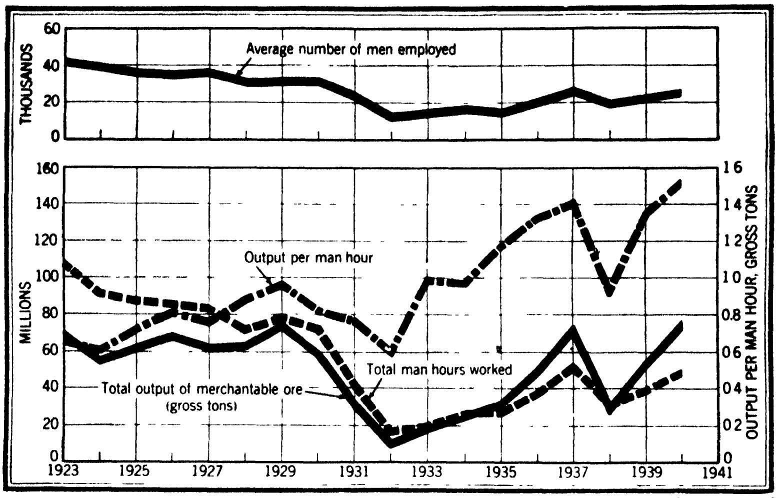

FIGURE 3.—Trends in number of men employed at iron-ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–40.

gross tons of merchantable ore—an average output of 1.512 tons per man-hour—whereas in 1939, 21,859 men working 39,055,362 man-hours produced 51,731,730 tons of merchantable ore—an average output of 1.325 tons per man-hour. Thus, although the average number of men employed increased 15 percent from 1939 to 1940 and the number of man-hours gained 25 percent, the output of merchantable ore advanced 42 percent, resulting in a 14-percent increase in the output per man-hour. The labor requirements in 1940 were relatively smaller than in 1939 due to several factors—the proportionately larger output of open-pit mines, nearer-capacity production of operating units, and the stripping of proportionately much less overburden in preparation for future mining.

In 1940 the number of man-hours of labor increased over 1939 in all districts, but the increases in the Lake Superior and Southeastern districts (24 and 25 percent, respectively) were relatively less than in the other chief producing districts. The increases in the Northeastern and Western districts were 26 and 33 percent, respectively. In the Lake Superior district, the output of merchantable ore per man-hour in 1940 reached 2.032 tons—18 percent more than in 1939 and 14 percent more than the previous record year of 1937. The large gain

(19,791,715 tons or 47 percent) in Lake Superior output in 1940 over 1939 required the employment of 16 percent more men. This, plus an 8-percent increase in the average number of days worked, resulted in a 24-percent rise in the number of man-hours worked. Much of the Lake Superior output comes from Minnesota, where open pits furnished 91 percent of the State total in 1940. Because of this pre-

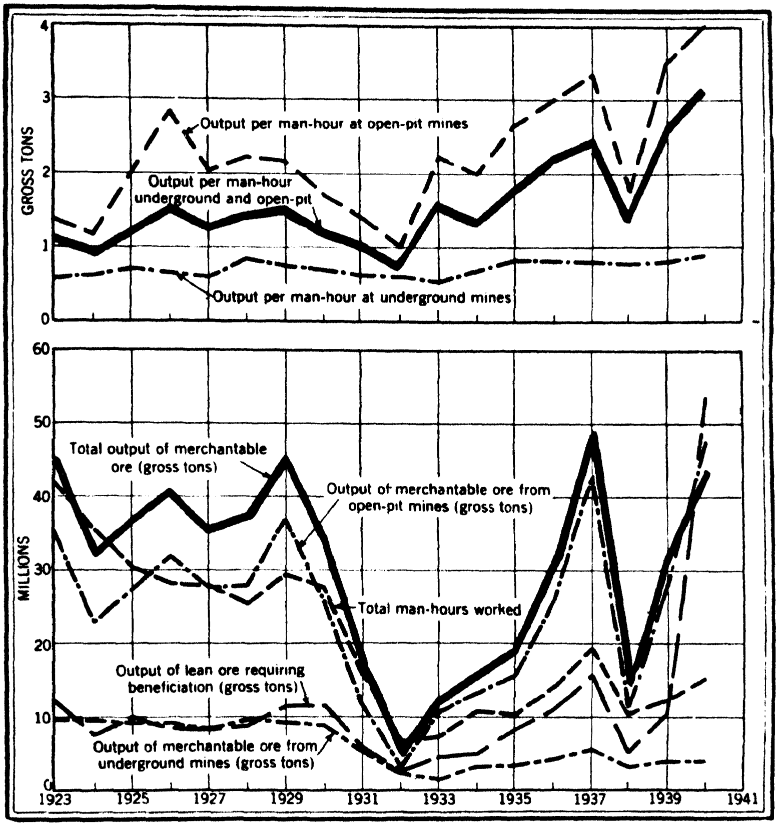

FIGURE 4.—Trends in output of merchantable iron ore per man-hour at open-pit mines in Minnesota compared with production of merchantable and lean ore and total man-hours worked, 1923–40.

ponderant production from open pits, the output per man-hour in Minnesota is greater than in any other State or district and in 1940 amounted to 3.136 tons—a 22-percent increase over 1939. Although advances in mechanization, more efficient mining methods, and better management of mines have done much to increase output in recent years, most of the gain is due to expansion of open-pit operations in Minnesota. For example, although about 75 percent of the merchantable ore output of Minnesota in 1923–32 came from open-pit mines, 85 percent was so produced in 1933–40. Minnesota contributed 61 percent of the total merchantable ore produced in 1923–40, and during this period the output at open-pit mines averaged 2.189 tons per man-hour compared with only 0.707 ton per man-hour at underground mines.

The greater output per man-hour in recent years also was due partly to the stripping of proportionately less overburden in Minne-

sota in 1933–40 than in 1923–32. In 1933–40 about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined in Itasca and St. Louis Counties, Minnesota, whereas in 1923–32 about one-half cubic yard of overburden was recovered for each ton of ore mined. Any material shift in the labor force used for direct mining of the ore at the expense of that used in stripping will result in a much higher output per man-hour for any year.

Another factor that affects the output per man-hour is the tendency to mine leaner ore. Proportionately more lean ore requiring beneficiation has been mined in Minnesota in recent years than in 1923–32. In 1933–40, for instance, beneficiated ore represented 21 percent of

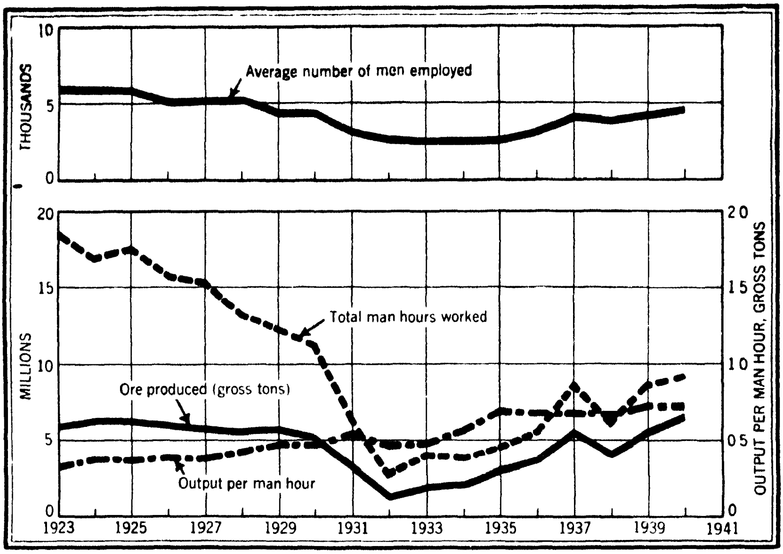

FIGURE 5.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923–40.

the total merchantable ore compared with an average of only 16 percent in 1923–32.

Most of the ore mined in the Southeastern district—the second-largest producing region—is obtained from underground operations. The output of merchantable ore per man-hour decreased slightly from 0.644 ton in 1939 to 0.639 ton in 1940. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 4,623 men working 9,122,985 man-hours in 1940 produced 6,541,407 tons of merchantable ore, equivalent to an average output of 0.717 ton per man-hour. Virtually all ore produced in Jefferson County comes from underground mines. In comparing the man-hour cost of mining ore in this county, with that of underground mines in the Lake Superior district one should remember that, whereas the ore in the Lake Superior district is much richer in iron, the ore from the Jefferson County mines contains enough or almost enough lime to make it self-fluxing. Thus, the lower iron content is partly offset by the self-fluxing nature of the ore.

Figure 5 shows trends in production and employment at iron-ore mines in Jefferson County, Ala., 1923–40.

In the Northeastern district the average output of merchantable ore per man-hour decreased to 0.594 ton in 1940 from 0.654 ton in 1939. The drop in productivity was due in part to relatively larger increases in output from mines in New Jersey and New York, where virtually the entire output came from underground operations, resulting in a relatively higher expenditure of labor than in Pennsylvania, where output is predominantly from the open pit at Cornwall and productivity is high.

Trends in the technology, employment, and output per man in iron-ore mining over the past half century are covered in a recent report by Yaworski, Kiessling, and others.[10]

The accompanying table shows employment at iron mines and beneficiating plants, quantity and tenor of ore produced, and average output per man by districts and States in 1940. Corresponding statistics and supplementary data are given in Minerals Yearbook, 1934 to 1940, inclusive, and Minerals Yearbook, Review of 1940.

[10] Yaworski, N., Kiessling, O E., and others, Technology, Employment, and Output per Man in Iron Mining· W. P. A. Nat. Research Project, in cooperation with Bureau of Mines, U. S. Department of Interior, June 1940, 264 pp.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1940, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment: Average number of men employed	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per shift	Man-hours: Total	Production: Crude ore (partly estimated), gross tons	Merchantable ore: Gross tons	Merchantable ore: Iron contained: Gross tons	Merchantable ore: Iron contained: Percent natural	Average per man (gross tons): Crude ore (partly estimated): Per shift	Crude ore: Per hour	Merchantable ore: Per shift	Merchantable ore: Per hour	Merchantable ore: Iron contained: Per shift	Iron contained: Per hour
Lake Superior:															
Michigan	6,981	245	1,710,740	8.0	13,681,841	12,472,448	12,472,448	6,489,049	52.03	7.291	0.912	7.291	0.912	3.793	0.474
Minnesota	8,519	224	1,905,481	8.0	15,223,399	53,617,491	47,736,810	24,993,261	52.36	28.139	3.522	25.052	3.136	13.117	1.642
Wisconsin	647	260	168,345	8.0	1,346,760	1,262,065	1,262,065	673,527	53.35	7.497	.937	7.497	.937	4.001	.500
	16,147	234	3,784,566	8.0	30,252,000	67,352,004	61,471,323	32,155,837	52.31	17.796	2.226	16.243	2.032	8.497	1.063
Southeastern States:															
Alabama	5,593	245	1,369,194	8.1	11,137,408	9,413,519	7,316,127	2,665,246	36.43	6.875	.845	5.343	.657	1.947	.239
Georgia						240,650	101,286	47,747	47.14						
Mississippi									40.90						
Tennessee	414	148	61,199	8.3	506,004	67,218	26,893	12,807	47.24	5.031	.608	2.094	.253	.989	.120
Texas									51.50						
Virginia									54.32						
	6,007	238	1,430,393	8.1	11,643,412	9,721,387	7,444,306	2,725,800	36.62	6.796	.835	5.204	.639	1.906	.234
Northeastern States:															
New Jersey	857	268	229,881	8.0	1,839,050	1,292,794	659,425	411,124	62.35	5.624	.703	2.869	.359	1.788	.224
New York	1,664	310	515,985	8.0	4,151,289	3,817,196	2,900,499	1,386,752	66.56	7.398	.920	5.621	.699	2.688	.334
Pennsylvania									39.73						
	2,521	296	745,866	8.0	5,990,339	5,109,990	3,559,924	1,797,876	50.50	6.851	.853	4.773	.594	2.410	.300
Western States:															
California						1,071	1,071	675	63.03						
Missouri						53,638	53,638	27,708	51.66						
Oklahoma	197	172	33,801	8.8	298,798	1,797	1,797	809	45.02	11.509	1.302	11.509	1.302	6.286	.711
Utah						326,500	326,500	179,487	54.97						
Washington						5,386	5,386	3,501	65.00						
South Dakota						640	640	294	51.03						
Wyoming	256	267	68,431	8.0	547,448	831,314	831,314	424,220		12.148	1.519	12.148	1.519	6.199	.775
	453	226	102,232	8.3	846,246	1,220,346	1,220,346	636,694	52.17	11.937	1.442	11.937	1.442	6.228	.752
	25,128	241	6,063,057	8.0	48,731,997	83,403,727	73,695,899	37,316,207	50.64	13.756	1.711	12.155	1.512	6.155	.766

WORLD PRODUCTION

The following table shows the production of iron ore, by countries, from 1937 to 1941, insofar as statistics are available. Although complete returns for 1941 are not yet available it is evident that world production was much greater than in 1940.

World production of iron ore, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
North America:					
Canada	5,622	5,281	117,583	[2] 367,194	[2] 362,337
Cuba	[2] 496,258	[2] 154,540	[2] 283,613	160,339	192,851
Guatemala	101				
Mexico	136,018	118,251	143,873	110,783	110,134
Newfoundland	1,635,554	1,707,180	1,679,625	1,532,990	981,735
United States	73,250,649	28,903,861	52,562,024	74,878,718	93,892,753
South America:					
Brazil [3]	209,715	359,115	396,938	255,548	420,756
Chile [4]	1,489,637	1,608,399	1,626,490	1,749,840	1,702,692
Europe:					
Belgium	265,540	180,920	177,370	(5)	(5)
Bulgaria	11,920	16,771	20,115	30,000	(5)
Czechoslovakia	1,836,495	(6)	(5)	(5)	(5)
France	37,839,000	33,137,000	(5)	(5)	(5)
Germany [7]	9,575,234	10,938,650	(5)	(5)	(5)
Austria	1,884,694	2,600,063	(5)	(5)	(5)
Greece	300,498	348,613	307,284	(5)	(5)
Hungary	290,044	369,935	370,000	(5)	(5)
Italy	997,805	990,043	(5)	(5)	(5)
Luxemburg	7,766,254	5,140,632	(5)	(5)	(5)
Norway	1,008,225	1,425,297	1,340,408	(5)	(5)
Poland	780,152	872,591	(5)	(5)	(5)
Portugal	7,700	2,519	418	285	287
Rumania	129,060	139,185	131,992	(5)	(5)
Spain	1,269,742	2,544,945	2,200,000	2,886,973	[8] 1,352,000
Sweden	14,952,549	13,928,023	13,787,202	(5)	(5)
Switzerland	[3] 148,578	[3] 133,998	[3] 171,279	200,000	(5)
U. S. S. R. [9]	26,000,000	26,529,700	(5)	(5)	(5)
United Kingdom: Great Britain [10]	14,443,146	12,049,531	(5)	(5)	(5)
Yugoslavia	629,172	606,884	666,816	(5)	(5)
Asia:					
Burma	23,834	18,340	26,680	(5)	(5)
Chosen	207,500	(6)	(5)	(5)	(5)
India, British	2,883,548	2,787,711	3,166,087	(5)	(5)
Indochina	33,285	130,298	136,000	32,861	(5)
Japan	(6)	(6)	(5)	(5)	(5)
Malay States:					
Federated	1,165	938	780	972	(5)
Unfederated	1,686,990	1,606,289	1,991,173	1,872,903	(5)
Philippine Islands [2]	601,190	910,952	1,154,738	1,191,641	[11] 852,080
Turkey		71,373	143,277	130,338	(5)
U. S. S. R.	(9)	(9)	(5)	(5)	(5)
Africa:					
Algeria	2,427,230	3,105,037	[12] 2,750,000	(5)	(5)
Belgian Congo		2,650	(5)	6,100	(5)
Morocco:					
French	66,864	266,100	(5)	(5)	(5)
Spanish	1,424,737	1,341,658	[3] 1,038,006	[3] 389,337	(5)
Northern Rhodesia	528	208	138	(5)	(5)
Sierra Leone	644,160	875,789	(5)	(5)	(5)
South-West Africa	14,280	23,861	19,500	(5)	(5)
Tunisia	943,763	822,053	764,731	(5)	(5)
Union of South Africa	461,796	505,314	490,136	638,757	[13] 427,685

[1] In addition to the countries listed, China, Egypt, Eritrea, Finland, French West Africa, Madagascar, and New South Wales report production of iron ore, but complete data are not available.
[2] Shipments.
[3] Exports.
[4] Production of Tofo Mines.
[5] Data not available.
[6] Estimate included in total.
[7] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[8] January to October, inclusive.
[9] U. S. S. R. in Asia included with U. S. S. R. in Europe.
[10] Exclusive of bog ore, which is used mainly for purification of gas.
[11] January to July, inclusive.
[12] Estimated.
[13] January to June, inclusive.

World production of iron ore, 1937–41, by countries, in metric tons—Continued

Country	1937	1938	1939	1940	1941
Oceania:					
Australia:					
Queensland	4,551	5,207	4,003	(5)	(5)
South Australia	1,896,370	2,281,404	2,613,036	(5)	(5)
Tasmania	62		(5)	(5)	(5)
New Caledonia		36,279	83,567	176,600	(5)
New Zealand	580	1,238	1,611	1,208	(5)
	212,000,000	162,000,000	(5)	(5)	(5)

[5] Data not available.

PIG IRON

PRODUCTION AND SHIPMENTS

Domestic production of pig iron, exclusive of ferro-alloys, increased 19 percent in 1941 over 1940 and established a new record. The output in 1941 comprised 54,981,489 net tons using coke and 103,957 tons using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1941, with 31 percent of the total; Ohio ranked second, with 23 percent. Of the pig iron manufactured in 1941, it is calculated that 1,381,893 tons valued at $27,404,941 were made from 2,388,610 tons of foreign ores, including ore from Africa, Australia, Brazil, Canada, Chile, Cuba, Palestine, and Spain, indicating an average yield of 57.85 percent from imported ore. Domestic ore (92,016,057 tons) and cinder, scale, and purchased scrap (8,175,648 tons) totaling 100,191,705 tons were reported as used in the manufacture of 53,703,553 tons of pig iron, indicating an average pig-iron yield of 53.60 percent from domestic materials. In addition, 1,588,000 tons of home scrap and 3,983,000 tons of flue dust were consumed in making pig iron in 1941.

Pig iron produced and shipped in the United States, 1940–41, by States

State	Produced		Shipped from furnaces			
	1940	1941	1940		1941	
	Net tons	Net tons	Net tons	Value	Net tons	Value
Alabama	3,423,296	3,696,566	3,476,072	$49,706,851	3,712,018	$64,037,109
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	4,047,376	5,354,767	4,093,623	73,882,065	5,461,459	113,558,606
Indiana	5,337,935	6,374,331	5,333,915	97,407,801	6,393,223	135,655,190
Iowa	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	290,514	328,912	290,610	(1)	329,125	(1)
Maryland	2,342,519	2,353,203	2,350,773	(1)	2,372,932	(1)
Massachusetts	(1)	(1)	(1)	(1)	(1)	(1)
Michigan	1,349,775	1,350,450	1,340,402	18,472,588	1,360,139	21,384,383
Minnesota	277,069	359,263	282,728	(1)	369,549	(1)
New York	3,009,567	3,571,901	3,206,162	54,150,107	3,724,989	66,718,244
Ohio	10,094,448	12,787,243	10,275,696	193,283,920	12,995,298	268,660,861
Pennsylvania	14,294,453	16,856,917	14,571,517	282,666,561	16,340,965	344,298,135
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)		(1)	(1)	(1)	(1)
West Virginia	921,812	1,019,150	941,299	(1)	1,032,148	(1)
Undistributed	[2] 815,203	[2] 1,029,743	[2] 796,132	[2] 70,872,139	[2] 1,131,796	[2] 97,498,488
	46,203,967	55,085,446	46,958,929	840,442,032	55,223,641	1,111,811,316

[1] Included under "Undistributed." [2] Includes statistics for States entered as "(1)."

Shipments of pig iron, exclusive of ferro-alloys, increased 18 percent in quantity and 32 percent in value in 1941 over 1940. The values given represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items that are figured in some of the market prices for pig iron published by trade journals.

Pig iron shipped from blast furnaces in the United States, 1940–41, by grades

Grade	1940			1941		
	Net tons	Value		Net tons	Value	
		Total	Average		Total	Average
Charcoal	72, 461	$1, 755, 735	$24 23	144, 076	$3, 618, 686	$25. 12
Foundry	2, 737, 224	48, 600, 640	17 76	3, 125, 413	61, 309, 626	19. 62
Basic	35, 004, 116	606, 481 057	17 33	40, 642, 051	801, 328, 939	19 72
Bessemer	6, 657, 388	130, 929, 263	19 67	7, 900, 369	170, 051, 203	21. 52
Low-phosphorus	443, 088	11, 156, 558	25 18	508, 727	13, 881, 518	27. 29
Malleable	1, 778, 770	35, 713, 749	20 08	2, 643, 497	56, 677, 298	21 44
Forge	3, 943	89, 309	22 65	1, 212	30, 094	24. 83
All other (not ferro-alloys)	261, 939	5, 715, 721	21 82	258, 296	4, 913, 952	19. 02
	46, 958, 929	840, 442, 032	17 90	55, 223, 641	1, 111, 811, 316	20. 13

The number of furnaces in blast June 30 and December 31 and the total number of blast furnaces recorded for 1940 and 1941 were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1940–41 [1]

State	In blast June 30, 1940	December 31, 1940			In blast June 30, 1941	December 31, 1941		
		In	Out	Total		In	Out	Total
Alabama	17	17	2	19	17	19	1	20
Colorado	3	3		3	3	3	1	4
Illinois	11	15	8	23	18	20	3	23
Indiana	16	18	1	19	19	19		19
Kentucky	2	2		2	2	2		2
Maryland	6	6		6	6	7		7
Massachusetts		1		1	1	1		1
Michigan	8	8		8	7	8		8
Minnesota	2	2		2	2	2		2
New York	11	13	2	15	15	15	1	16
Ohio	40	46	2	48	47	46	2	48
Pennsylvania	61	68	9	77	70	70	7	77
Tennessee	2	2	1	3	2	5		5
Utah	1	1		1	1	1		1
Virginia	1	1		1	1	1		1
West Virginia	3	3		3	3	4		4
	184	206	25	231	214	223	15	238

[1] American Iron and Steel Institute.

VALUE AT BLAST FURNACES

The average value of all kinds of pig iron given in the accompanying table is based upon reports of producers to the Bureau of Mines. The figures represent the approximate values f. o. b. blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces was $20.13 a net ton in 1941—$2.23 more than in 1940.

Average value per net ton of pig iron at blast furnaces in the United States, 1937–41, by States

State	1937	1938	1939	1940	1941
Alabama	$14.89	$13.10	$14.42	$14.30	$17.25
Illinois	18.85	18.15	18.02	18.05	20.79
Indiana	18.85	18.29	18.03	18.26	21.22
Michigan	15.17	15.67	14.79	13.78	15.72
New York	18.44	18.58	18.29	16.89	17.91
Ohio	19.31	18.17	18.12	18.81	20.67
Pennsylvania	19.40	19.30	18.52	19.40	21.07
Other States [1]	16.89	15.21	14.91	15.20	18.62
Average for United States	18.54	17.51	17.44	17.90	20.13

[1] Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Utah, Virginia, and West Virginia.

COMMERCIAL QUOTATIONS

The average monthly prices of foundry, basic, and bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces, according to published market quotations, are summarized in the following table:

Average monthly prices per net ton of chief grades of pig iron, 1940–41 [1]

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basis pig iron at Valley furnaces	
	1940	1941	1940	1941	1940	1941	1940	1941
January	$20.54	$21.43	$17.30	$17.30	$20.98	$21.88	$20.09	$20.98
February	20.54	21.43	17.30	17.30	20.98	21.88	20.09	20.98
March	20.54	21.43	17.30	17.51	20.98	21.88	20.09	20.98
April	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
May	20.54	21.43	17.30	18.20	20.99	21.88	20.09	20.98
June	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
July	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
August	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
September	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
October	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
November	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
December	20.54	21.43	17.30	18.20	20.98	21.88	20.09	20.98
Average	20.54	21.43	17.30	17.99	20.98	21.88	20.09	20.98

[1] Metal Statistics, 1942.

FOREIGN TRADE

There were no imports for consumption of pig iron during the first 9 months of 1941.

Pig iron imported for consumption in the United States, 1937–41, by countries, in net tons

Country	1937	1938	1939	1940	1941 (Jan.–Sept.)
North America: Canada	7,434	2,975	7,685	3,826	
South America: Brazil			174		
Europe:					
Denmark			1		
Germany	571				
Netherlands	32,225	15,944	7,250		
Norway	980	952			
Sweden	672	230	292		
U. S. S. R.	5,131				
United Kingdom	112	47			
Asia: India, British	77,976	13,900	27,821	7,645	
	125,101	34,048	43,223	11,471	
Value	$1,701,304	$598,461	$663,091	$189,379	

Exports of pig iron, January through September 1941, totaled 513,561 net tons valued at $14,081,065 compared with 620,336 net tons having a value of $13,057,901 for entire year 1940. Details regarding destination of exports are not available for publication.

Pig iron exported from the United States, 1940–41, by countries, in net tons

Country	1940	1941 [1] (Jan.–Sept.)	Country	1940	1941 [1] (Jan.–Sept.)
North America:			Europe—Continued.		
Canada	30,497		United Kingdom	515,061	
Other North America	1,315		Other Europe	6,815	
South America:			Asia:		
Argentina	1,543		British Malaya	1,792	
Chile	2,465		China	8,290	
Colombia	279		Hong Kong	224	
Peru	731		Japan	6,368	
Uruguay	1,191		Netherlands Indies	1,760	([1])
Other South America	347		Philippine Islands	537	
Europe:		([1])	Other Asia	984	
Belgium	3,537		Africa:		
Greece	2,500		Gold Coast	300	
Hungary	4,299		Union of South Africa	10,372	
Italy	336		Other Africa	77	
Netherlands	252		Oceania: New Zealand	22	
Norway	2,184				
Portugal	3,471			620,336	513,561
Sweden	11,883		Value	$13,057,901	$14,081,065
Switzerland	904				

[1] Details by countries not available for publication.

CONSUMPTION

Consumption of pig iron rose 22 percent in 1941 over 1940. Pig iron, a product of the blast furnace, is a semiraw material and, except for the small quantity used in direct castings, moves to other-type furnaces for further refining or mixture with other required ingredients. In general, it goes to steel-making or iron-making furnaces. By far the larger part is taken to steel-making furnaces (open-hearth, bessemer, and electric) for refining and processing into steel. In 1941, 86.4 percent of the pig iron was consumed in steel making. Direct castings took 2.8 percent of the 1941 total, and the remaining 10.8 percent was consumed in iron-making furnaces, of which the cupola is by far the most important. The consumption of pig iron, by types of furnace, for 1938 to 1941 is shown in the following table. Typically, the quantities of pig iron used in these furnaces are supplemented by the addition of ferrous scrap. The proportion of pig iron to scrap used in steel furnaces decreased in 1941 compared with 1940.

Consumption of pig iron in the United States, 1938–41, by type of furnace

Type of furnace or equipment	1938		1939		1940		1941	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Open-hearth	15,376,896	74.2	26,826,172	76.2	36,297,250	78.6	42,481,404	75.6
Bessemer	2,179,574	10.5	3,603,199	10.2	3,828,978	8.3	5,993,264	10.7
Electric	17,800	.1	30,542	.1	46,506	.1	72,758	.1
Cupola [1]	2,693,193	13.0	3,349,198	9.5	4,106,119	8.9	5,388,747	9.6
Air Brackelsberg	207,776	1.0	329,317	.9	374,187	.8	604,835	1.1
Crucible	244	([2])	92	([2])	184	([2])	207	([2])
Puddling	5,984	([2])	27,959	.1	28,293	.1	54,183	.1
Direct castings [1]	243,404	1.2	1,066,220	3.0	1,504,311	3.2	1,590,074	2.8
	20,724,871	100.0	35,232,699	100.0	46,185,828	100.0	56,185,472	100.0

[1] Some pig iron used in making direct castings included in cupola. [2] Less than 0.05 percent.

The consumption of pig iron in this country is widespread, and plants using pig iron are situated in all 48 States, the District of Columbia, and Alaska. As expected from the uses of pig iron, consumption is concentrated largely in the iron- and steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1941 used about 98 percent of the pig iron, Pennsylvania (the leading consumer) taking about 31 percent of the total and Ohio (the second-largest consumer) nearly 21 percent. Of the chief consuming areas in 1941, the North Central district made the largest gain over 1940—26 percent compared with 19 percent in the Middle Atlantic district and 11 percent in the Southeastern district (including the Birmingham district of Alabama). The following table shows the distribution of pig-iron consumption by States from 1938 to 1941.

Consumption of pig iron in the United States, 1938–41, by States and districts

State and district	1938		1939		1940		1941	
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons
Connecticut	57	53,476	59	82,88[illegible]	60	96,574	62	143,862
Maine	16	4,538	15	6,720	15	8,392	14	11,467
New Hampshire	14	1,398	15	1,826	14	2,479	15	5,816
Massachusetts	98	66,947	97	115,534	104	146,886	107	242,265
Rhode Island	13	16,085	12	26,257	11	37,308	12	57,082
Vermont	13	3,381	12	6,530	12	10,358	14	16,276
Total New England	211	145,825	210	239,753	216	301,997	224	476,768
Delaware	7	223,937	7	281,000	7	362,758	7	449,486
New Jersey	80		79		81		80	
New York	194	1,038,632	193	1,817,251	190	2,403,248	199	2,765,216
Pennsylvania	345	5,355,260	365	10,152,661	348	14,634,036	391	17,573,102
Total Middle Atlantic	626	6,617,829	644	12,250,912	626	17,400,042	677	20,787,804
Alabama	59	1,562,813	57	2,378,774	59	2,809,064	74	3,142,958
District of Columbia	1	1,515,824	2	2,365,534	1	2,825,324	1	2,974,834
Kentucky	21		24		24		23	
Maryland	26		26		25		26	
West Virginia	22	562,151	23	880,062	23	1,016,445	28	1,218,175
Florida	10	38,041	12	61,655	13	73,045	12	83,895
Georgia	40		40		40		43	
Mississippi	6	366	7	362	9	365	7	621
North Carolina	30	12,240	32	13,853	33	15,901	40	18,591
South Carolina	13	1,717	13	2,251	14	2,355	12	5,090
Tennessee	53	133,981	52	150,564	50	162,936	52	254,840
Virginia	44		46		44		45	
Total Southeastern	325	3,827,133	334	5,853,055	335	6,905,435	363	7,699,004
Arkansas	5	2,013	6	2,003	6	2,107	6	2,600
Oklahoma	7		6		8		7	
Louisiana	8		8		8		7	
Texas	23	3,014	24	2,572	23	2,327	27	3,107
Total Southwestern	43	5,027	44	4,575	45	4,434	47	5,707
Illinois	182	1,645,013	179	2,770,693	183	3,764,275	208	4,915,372
Indiana	120	2,118,178	124	3,830,053	126	5,522,177	131	6,833,091
Iowa	51	43,920	49	54,834	52	63,834	52	104,368
Minnesota	52	147,412	53	185,976	51	214,340	53	266,768
Missouri	50	28,357	53	37,760	53	45,48[illegible]	51	80,065
Kansas	15	2,832	14	3,513	13	3,742	15	4,251
Nebraska	8		7		8		10	
Michigan	158	1,098,431	168	1,849,622	173	2,232,069	174	2,478,219
Wisconsin	116		118		115		111	
South Dakota			2	148	2	106	2	86
Ohio	276	4,787,[illegible]42	290	7,558,466	285	9,080,242	319	11,676,773
Total North Central	1,028	9,871,485	1,057	16,291,065	1,061	20,926,271	1,126	26,358,993
Arizona	1	25	1	36	1	35	2	67
Nevada					1			
New Mexico					1			
Colorado	17	152,729	19	412,220	10	457,487	18	644,393
Utah					7			

Consumption of pig iron in the United States, 1938–41, by States and districts—Continued

State and district	1938		1939		1940		1941	
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons
Idaho Wyoming Montana	4	220	5	308	1 1 3	687	4	578
Total Rocky Mountain	22	152,974	25	412,564	25	458,209	24	645,038
Oregon Washington	18 33	5,518	19 37	6,312	19 36	7,519	18 33	9,830
California	90	99,080	95	174,463	93	181,921	98	202,328
Total Pacific Coast	141	104,598	151	180,775	148	189,440	149	212,158
Total United States	2,396	20,724,871	2,465	35,232,699	2,456	46,185,828	2,610	56,185,472

WORLD PRODUCTION

The accompanying table shows the production of pig iron by countries from 1937 to 1941 insofar as statistics are available. Although many of the leading world producers have been operating at a high rate for several years, the probable increase in world production during 1941 was due largely to the rise in United States production.

World production of pig iron (including ferro-alloys), 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Australia [2]	928,066	944,597	1,122,334	(3)	(4)
Belgian Congo	565	[5] 600	[5] 600	[5] 600	(4)
Belgium	3,803,750	2,426,130	3,058,730	[6] 2,200,000	(4)
Brazil	98,101	122,352	160,016	185,570	208,795
Canada	996,671	773,573	844,760	1,325,229	1,579,648
China (Manchuria)	[5] 650,000	[5] 700,000	[5] 700,000	[5] 700,000	(4)
Chosen	168,344	[5] 200,000	[5] 200,000	[5] 200,000	(4)
Czechoslovakia	1,675,064	1,233,987	[7] 1,000,000	(8)	(4)
Finland	11,258	27,000	[5] 30,000	(3)	(4)
France	7,916,000	6,061,322	[7] 7,900,000	[6] 4,600,000	(4)
Germany [9] Austria	15,959,806 387,602	18,596,000	[7] 20,300,000	[6] 21,000,000	(4)
Hungary	357,935	350,537	[7] 460,000	(3)	(4)
India, British	1,655,457	1,583,284	1,785,242	2,015,116	(4)
Italy	865,305	928,847	[7] 1,000,000	[6] 890,000	(4)
Japan	2,750,000	[5] 2,800,000	[5] 3,000,000	[6] 3,000,000	(4)
Luxemburg	2,512,495	1,500,000	[7] 1,800,000	[6] 1,000,000	(4)
Mexico	89,717	98,376	141,335	93,179	108,524
Netherlands	311,773	266,956	284,004	(3)	(4)
Norway	181,238	173,748	190,785	(3)	(4)
Poland	724,296	967,668	[7] 1,000,000	(8)	(4)
Rumania	127,234	132,681	[5] 140,000	(3)	(4)
Spain	141,053	442,574	456,813	581,343	530,000
Sweden	692,865	713,579	691,402	787,211	(4)
Union of South Africa	276,236	294,406	300,227	303,923	(4)
U. S. S. R.	14,520,000	15,179,856	[7] 15,200,000	[6] 15,500,000	(4)
United Kingdom	8,629,313	6,871,546	[7] 8,300,000	[6] 8,437,000	(4)
United States	37,749,575	19,474,677	32,321,653	43,026,030	[10] 49,972,415
Yugoslavia	41,006	58,458	61,106	(3)	(4)
	104,221,000	82,923,000	102,449,000	107,636,000	(4)

[1] Pig iron is produced in Chile, New Zealand, and the Philippine Islands in addition to countries listed, but production figures are not available.
[2] Year ended June 30.
[3] Estimate included in total.
[4] Data not available.
[5] Estimated production.
[6] Approximate production as published by The Iron Age, vol. 147, No. 1, January 2, 1941, p. 61.
[7] Approximate production as published by Steel, vol. 106, No. 1, January 1940, p. 269.
[8] Included in the German figure in 1940.
[9] Beginning with March 1935, production of the Saar is included with that of Germany.
[10] Does not include ferro-alloys.

FERRO-ALLOYS

Statistics concerning production and shipments of ferro-alloys during 1941 are omitted from this chapter to avoid the possibility of revealing information that might lend aid or comfort to the enemy.

FOREIGN TRADE

Imports of all alloys of the rarer metals are not recorded separately but are grouped as shown in the following table. Although spiegeleisen formed the bulk of the imports in 1940, there was a very noticeable decrease in withdrawals of this alloy and ferromanganese during the first 9 months of 1941, which totaled 7,268 net tons compared with 29,068 during the entire year 1940.

Imports of ferromanganese, January to September 1941, totaled 4,008 net tons containing 3,280 tons of manganese. Of this total, 3,993 net tons containing over 1 percent carbon came from Canada, and 15 tons of alloys containing less than 1 percent carbon were imported from Norway. All the ferrosilicon imported during the first 9 months of 1941 came from Canada.

From January to September 1941, inclusive, exports of ferro-alloys comprised 3,363 net tons of ferromanganese and spiegeleisen and 16,829 tons of other ferro-alloys, compared with 14,600 net tons of ferromanganese and spiegeleisen and 27,401 tons of other ferro-alloys during the full year 1940.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1940–41, by varieties

Variety of alloy	1940			1941 (Jan.-Sept.)		
	Gross weight (net tons)	Content (net tons)	Value	Gross weight (net tons)	Content (net) tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	10,035	8,280	$1,121,133	3,993	3,267	$323,505
Containing not over 1 percent carbon	1,578	1,321	200,236	15	13	1,597
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	66	16,737	(1)	39	9,135
Spiegeleisen	17,455	(1)	638,732	3,260	(1)	119,524
Ferrochrome or ferrochromium:						
Containing 3 percent or more carbon	(2)	(3)	92	130	85	18,298
Ferrosilicon	10,257	1,235	262,397	10,140	2,881	337,789
Chrome or chromium metal	(4)	(1)	566			
Chromium and zirconium silicon and calcium silicide	1,066	(1)	154,424	56	(1)	8,337
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)	(1)	18	41,041	(1)	19	37,800

[1] Not recorded. [2] 1,400 pounds. [3] 1,020 pounds. [4] 1,000 pounds.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1940–41, by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1940		1941 (Jan.–Sept.)		1940		1941 (Jan.–Sept.)	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Canada			1,026	$113,197	1,235	$262,397	2,881	$337,789
Japan	39	$2,349						
Norway	9,562	1,319,020	13	1,597				
United Kingdom			2,241	210,308				
	9,601	1,321,369	3,280	325,102	1,235	262,397	2,881	337,789

Ferro-alloys and ferro-alloy metals exported from the United States, 1940–41, by varieties

Variety of alloy	1940		1941 (Jan.–Sept.)	
	Net tons	Value	Net tons	Value
Ferromanganese and spiegeleisen	14,600	$1,366,087	3,363	$437,534
Other ferro-alloys [1]	27,401	7,064,823	16,829	4,252,369

[1] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

STEEL

PRODUCTION

The high operating rate of production established during the closing months of 1940 continued through all of 1941. The production rate was above 93 percent of capacity during each month and averaged 97 percent for the year, compared with 82 percent in 1940. Capacity for producing steel increased 4,418,000 net tons during the year to reach a new record total of 88,570,000 net tons. The following figures covering the output of steel were compiled by the American Iron and Steel Institute. The production of steel ingots and castings in 1941 established a new record and totaled 82,839,259 net tons.

Of the 1941 total, 89.8 percent was made in open-hearth furnaces, 6.7 percent in bessemer converters, 3.5 percent in electric furnaces, and only 2,313 tons in crucible furnaces. The bulk (73,232,959 tons) of the total open-hearth output in 1941 was made in basic furnaces. Of the total output of steel ingots and castings, 82,434,367 net tons were ingots in 1941 compared with 66,649,864 tons in 1940.

Pennsylvania and Ohio continued to lead all other States and produced about 53 percent of the total steel, 51 percent of the open-hearth steel, and 76 percent of the bessemer steel.

Open-hearth steel ingots and castings manufactured in the United States, 1937–41, by States, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1937	1938	1939	1940	1941
New England States	309,143	183,297	286,850	322,753	462,754
New York and New Jersey	3,124,143	1,509,538	2,627,910	3,618,444	4,232,521
Pennsylvania	16,309,104	7,920,816	13,622,272	18,469,170	23,007,147
Ohio	10,156,097	6,016,902	9,913,454	11,769,780	14,746,523
Indiana	6,661,052	3,847,603	6,486,502	8,421,956	10,366,380
Illinois	4,382,916	2,184,251	3,687,874	4,963,457	5,998,679
Other States	10,882,524	7,417,609	11,784,938	14,007,523	15,575,615
	51,824,979	29,080,016	48,409,800	61,573,083	74,389,619

Bessemer-steel ingots and castings manufactured in the United States, 1937–41, by States, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1937	1938	1939	1940	1941
Ohio	1,957,435	1,202,916	1,439,629	1,459,807	2,265,987
Pennsylvania	930,093	389,827	1,109,081	1,366,017	1,966,779
Other States	976,390	513,597	810,206	882,749	1,345,305
	3,863,918	2,106,340	3,358,916	3,708,573	5,578,071

Steel electrically manufactured in the United States, 1937–41, in net tons

Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1937	912,027	34,975	947,002	1940	1,608,032	91,974	1,700,006
1938	524,843	40,784	565,627	1941	2,758,611	110,645	2,869,256
1939	951,522	77,545	1,029,067				

The steel output for 1941 includes 8,174,961 net tons of alloy-steel ingots and castings, which represent 10 percent of the total. This figure includes steels in which the minimum of the range specified in any of the elements named exceeds the following percentages: Nickel, 0.40 percent; chromium, 0.30 percent; copper, 0.50 percent; manganese, 1.65 percent; silicon, 0.50 percent; molybdenum, 0.10 percent; vanadium, tungsten, cobalt, titanium, and zirconium, any percentage. The output of alloy steels in 1941 increased 65 percent and that of total steel 24 percent over 1940. Of the total alloy-steel output in 1941, 65 percent came from basic open hearths, 5 percent from acid open hearths, 30 percent from electric furnaces, 933 tons from crucible furnaces, and 3,890 tons from bessemer furnaces.

Production of alloy-steel ingots and castings, 1937–41, by processes, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

Process	1937	1938	1939	1940	1941
Open-hearth, basic	2, 559, 200	1, 179, 031	2, 302, 273	3, 421, 961	5, 275, 247
Open-hearth, acid	164, 455	102, 089	156, 581	252, 965	433, 240
Bessemer	----------	13	3, 486	3, 990	3, 890
Crucible	270	5	231	255	933
Electric	672, 616	372, 372	749, 384	1, 286, 716	2, 461, 651
	3, 396, 541	1, 653, 510	3, 211, 955	4, 965, 887	8, 174, 961

From the foregoing tables it will be seen that most of the steel made in electric furnaces (86 percent in 1941) is alloy steel. Typically, steels with higher alloy content are made in electric furnaces and steels with lower alloy content by the open-hearth process.

FOREIGN TRADE AND PRODUCTION

Although data for only the first 9 months of 1941 are available for publication, it is evident that exports of iron and steel products continued at a high rate during the year. Exports of iron ore, pig iron, and ferro-alloys are covered in other sections of this report.

Imports for consumption of iron and steel products during the first 9 months of 1941 were very small—almost negligible compared with exports. The bulk of imports was in the form of rails and narrow strips not over 16 inches wide. Imports of these two commodities totaled 6,777 net tons during the first 9 months of 1941.

According to the Iron and Steel Institute, the steel capacity of Great Britain is approximately 20,600,000 tons and that of U. S. S. R. about 21,800,000 tons a year. Germany, Czechoslovakia, Poland, and Austria have produced as much as 24,700,000, 2,500,000, 1,700,000, and 700,000 net tons, respectively, a year. French maximum production was 10,700,000 net tons in 1929, a figure considerably in excess of actual production of succeeding years. Also, 1929 was the year during which Belgian production reached a maximum of 4,500,000 tons of steel. Japan's steel capacity is about 7,100,000 tons a year based upon estimates of 1940 output. Italian steel capacity is about 3,000,000 tons, the production peak reached in 1939. Luxemburg's steel industry reached its maximum output in 1929 when 3,000,000 tons were produced. In addition, the steel output of Hungary, Spain, and Sweden is about 800,000, 700,000, and 1,200,000 net tons, respectively. Data for 1941 are not available for Australia and India, but in each country the output of steel in 1940 represented a new peak, Australia producing 1,300,000 tons and India 1,200,000 tons.

Iron and steel exported from the United States, 1940–41

Article	1940		1941 (Jan.-Sept.)	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	2,822,428	$98,542,659	1,642,002	$70,266,272
Iron and steel bars and rods:				
Iron bars	16,191	1,026,268	4,081	398,542
Concrete reinforcement bars	155,329	7,458,760	131,640	7,022,327
Other steel bars	649,151	41,741,271	314,864	31,890,728
Wire rods	320,622	14,060,723	132,784	6,604,619
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	12,510	803,521	22,688	1,048,387
Other plates, not fabricated	629,671	29,334,244	298,357	16,903,312
Skelp iron or steel	167,309	6,368,968	128,770	5,487,826
Iron and steel sheets, galvanized	184,020	14,160,612	86,278	7,109,944
Steel sheets, black, ungalvanized	533,671	34,530,127	339,018	23,070,155
Iron sheets, black	29,621	2,264,642	16,170	1,298,807
Strip band, and scroll iron or steel:				
Cold-rolled	72,803	6,552,171	47,506	4,969,762
Hot-rolled	150,203	8,594,550	79,855	5,060,301
Tin plate, terneplate, and taggers' tin	429,328	44,374,895	221,816	23,714,833
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	42,712	3,350,242	16,567	1,487,011
Structural shapes:				
Not fabricated	456,015	19,701,320	218,318	10,833,613
Fabricated	80,960	7,379,656	43,008	4,296,303
Plates fabricated, punched, or shaped	30,818	2,044,620	20,188	1,664,832
Metal lath	1,901	326,881	1,915	338,942
Frames, sashes, and sheet piling	15,769	1,097,112	7,914	630,265
Railway track material				
Rails for railways	289,020	11,364,737	125,852	5,438,493
Rail joints, splice bars, fishplates, and tie plates	11,596	870,524	13,839	866,024
Switches, frogs, and crossings	3,269	500,109	1,786	260,823
Railroad spikes	5,617	398,211	5,679	438,043
Railroad bolts, nuts, washers, and nut locks	3,724	430,637	1,755	284,546
Tubular products.				
Boiler tubes	30,117	3,961,676	44,960	6,278,373
Casing and oil-line pipe	203,447	18,165,437	102,183	8,377,558
Seamless black pipe, other than casing and oil line	34,025	4,411,354	27,911	3,428,830
Welded black pipe	57,968	5,077,148	54,754	4,980,746
Welded galvanized pipe	76,826	6,302,473	65,227	5,789,255
Malleable-iron screwed pipe fittings	5,023	1,463,394	4,192	1,255,909
Cast-iron screwed pipe fittings	2,816	530,478	951	222,132
Cast-iron pressure pipe and fittings	56,836	2,903,643	36,035	2,000,686
Cast-iron soil pipe and fittings	18,716	1,057,872	12,905	763,005
Riveted-steel or iron pipe and fittings	19,263	4,581,615	19,832	3,836,295
Wire and manufactures:				
Barbed	49,510	3,523,089	47,252	3,823,527
Galvanized wire	74,009	5,582,899	47,652	4,186,112
Iron or steel wire, uncoated	97,552	7,325,759	58,992	5,612,960
Wire rope, and strand	14,962	3,383,803	15,024	4,748,603
Woven-wire fencing and screen cloth	9,051	2,129,381	7,196	1,895,565
All other	23,497	3,990,240	16,809	2,864,603
Nails and bolts (except railroad):				
Wire nails	54,496	3,726,608	43,115	3 245,735
Horseshoe nails	1,650	382,574	2,231	503,471
All other nails, including tacks and staples	7,092	904,371	7,270	1,068,144
Bolts, nuts, rivets, and washers (except railroad)	37,387	7,087,062	35,284	7,933,035
Castings and forgings:				
Horsehoes and calks	398	48,185	582	69,517
Iron and steel, including car wheels and axles	70,224	10,806,824	83,895	17,161,838
Advanced manufactures:				
House heating boilers and radiators		340,004		306,570
Oil burners and parts		1,467,276		880,549
Tools:				
Axes		477,483		484,162
Shovels and spades		292,229		380,453
Hammers and hatchets		336,037		403,729
Saws, wood and metal cutting		2,078,253		2,427,285
All other tools		15,631,262		15,870,060

Iron and steel imported for consumption in the United States, 1940–41, by commodities

Commodity	1940		1941 (Jan.-Sept.)	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement	9	$227	2	$128
Solid or hollow, n. e. s.	2,074	257,435	402	52,931
Hollow and hollow drill steel	977	129,216	227	31,994
Bar iron	222	22,276	17	1,671
Wire rods, nail rods, and flat rods up to 6 inches in width	4,465	452,428	118	32,907
Boiler or other plate iron or steel, except crucibles and saw-plate steel	(1)	11	46	3,483
Sheets or plates of iron or steel	16	16,951	7	9,285
Steel ingots, blooms, and slabs	4	179	1,051	119,517
Billets, solid or hollow	491	54,094	62	5,476
Die blocks or blanks, shafting, etc	13	3,102	12	6,878
Circular saw plates	21	10,062	21	8,865
Sheets of iron or steel, common or black and boiler or other plate iron or steel	2	254	2	145
Sheets and plates and steel, n. s. p. f.	114	20,179	29	1,512
Tin plate, terneplate, and tagger's tin	153	39,422	106	27,461
Manufactures:				
Structural iron and steel	859	38,358	322	48,831
Rails for railways	1,467	32,132	4,295	81,042
Rail braces, bars, fishplates or splice bars, and tie plates	312	18,421	656	34,357
Pipes and tubes.				
Cast-iron pipe and fittings	502	15,619	1	166
Other pipes and tubes	3,444	432,003	852	98,396
Wire:				
Barbed	959	7,441	(1)	21
Round iron and steel	985	219,741	35	8,311
Baling	10	709		
Telegraph, telephone, etc., except copper, covered with cotton jute, etc	1	1,260	(1)	325
Flat and steel strips not thicker than ¼-inch and not over 16 inches wide	2,481	1,485,307	2,482	1,430,968
Rope and strand	587	96,861	105	21,823
Galvanized fencing wire and wire fencing	1	30	1	70
Hoop or band iron or steel for baling	694	21,570		
Hoop, band, strips, or scroll iron or steel, n. s. p. f.	10	4,889		
Nails	126	44,910	27	8,611
Castings and forgings, n. e. s.	685	124,830	285	65,215

(1) Less than 1 ton.

MANGANESE AND MANGANIFEROUS ORES

By NORWOOD B. MELCHER [1]

SUMMARY OUTLINE

GENERAL PERSPECTIVE

In 1941 history's greatest armament race was under way and overshadowed all other influences affecting the activity of the world's metal and mineral industries. To meet the demand for manganese created by an all-time record year of world steel production, all possible sources were stressed to the limit during 1941. The domestic production (shipments from domestic mines) of manganese ore containing 35 percent or more manganese in 1941 increased 95 percent over 1940; shipments were reported from 18 States in 1941, compared with 13 in 1940, and totaled 78,388 long tons. In addition, 457,287 long tons of ore containing 10 to 35 percent manganese and 820,290 tons of ore containing 5 to 10 percent manganese were shipped during the year.

A domestic manganese war program of sufficient scope to free American steel and alloy production from its present reliance on foreign sources, with accompanying dependence on ocean shipping and naval convoy where necessary, has been outlined by the Bureau of Mines.

The program is designed to provide enough manganese to produce 87 million tons of steel annually. It covers utilization of low-grade domestic manganese ores and was made possible through the development of several processes by the Bureau of Mines during years of study in laboratories and pilot plants.

The program provides for the establishment of 8 mills, 3 hydrometallurgical plants (including 1 electrolytic unit), and 1 matte smelting plant. The proposal is to establish these 12 plants in 10 locations in 8 States—Arizona, Arkansas, Minnesota, Montana, Nevada, New Mexico, South Dakota, and Utah. Construction periods for these plants would range from 9 to 12 months. Even with an increase of imports from Cuba and Mexico, a reduction of shipping from other foreign sources may result in a deficiency in manganese in 1943 unless additional domestic ores are processed. Supplies adequate for the present year and part of 1943 are now on hand.

It is estimated that a capital investment of less than $38,000,000 in mining operations and processing plants will be required to produce the quantity of manganese specified. A minimum of 526,000 tons of

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

metal annually is provided for in the program, with a maximum of approximately 560,000 tons. This includes 12,000 tons of electrolytic manganese, which is of special value in low-carbon steels and in certain types of stainless steels. Approximately 11,500,000 tons of domestic ores could be processed annually.

The program proposed by the Bureau of Mines is divided into two steps.

Six custom mills and one hydrometallurgical plant would be established first to handle the higher-grade ores. After careful consideration of the larger resources available and the methods of treatment suitable to each ore, the following locations were proposed: Custom concentrators at Deming, N. Mex.; Batesville, Ark.; Parker Dam, Ariz.; Philipsburg, Mont.; Delta, Utah; and Garfield, Utah; and a leaching plant and electrolytic plant at Las Vegas, Nev. These plants could produce a minimum of 213,620 tons of manganese (metal equivalent) annually and would require an investment of $14,100,000.

The second step in the program includes a concentrating plant at Artillery Peak, Ariz., one on the Cuyuna Range in Minnesota, and one at Chamberlain, S. Dak. These plants could produce a minimum of 312,175 tons of manganese (metal equivalent) annually and would require an investment of $24,000,000.

Ore from 50 different deposits could be used in the program, including properties in the Batesville-Cushman district in Arkansas; the Aquila, Parker Dam, and Wickenburg areas in Arizona; the Paymaster district in California; the Granite County, West Butte, and Wickes areas in Montana; the Drum Mountain, Simpson Mountains, Kanab, Marysvale, and Tintic districts in Utah; the Caliente, Ely, Pioche, Battle Mountain, and Valmy areas in Nevada; the Three Kids, Annex, and Las Vegas-Wash areas in Nevada; the Cleveland area in Idaho; the Cuyuna Range area in Minnesota; and the South Dakota area near Chamberlain.

The program includes the advance purchase and stock-piling of ores during the period of construction of the mills and hydrometallurgical plants so that full operation could be attained rapidly.

Figure 1 shows imports and domestic production of manganese ore over a 42-year period.

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1937–41, in long tons

	1925–29 (average)	1937	1938	1939	1940	1941
Manganese ore:						
Total shipments containing 35 percent or more Mn	59,312	40,241	25,321	29,307	40,123	78,388
Shipments of metallurgical ore	[1] 41,892	26,419	16,989	18,580	27,158	65,939
Shipments of battery ore	17,420	6,447	4,959	7,767	9,271	10,178
Imports for consumption	600,000	911,919	483,586	627,129	1,282,079	1,530,876
Ferro-alloys:						
Production of ferromanganese	306,360	376,443	242,994	270,111	459,538	518,486
Imports of ferromanganese [2] [3]	[4] 50,590	23,888	21,118	33,414	8,573	5,085
Production of spiegeleisen	95,463	([5])	11,311	91,491	101,892	158,853
Imports of spiegeleisen [2]	7,298	16,841	17,248	38,264	15,585	4,233
Exports of spiegeleisen and ferromanganese	3,769	1,725	247	2,923	13,036	4,603

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.
[5] Bureau of Mines not at liberty to publish figures.

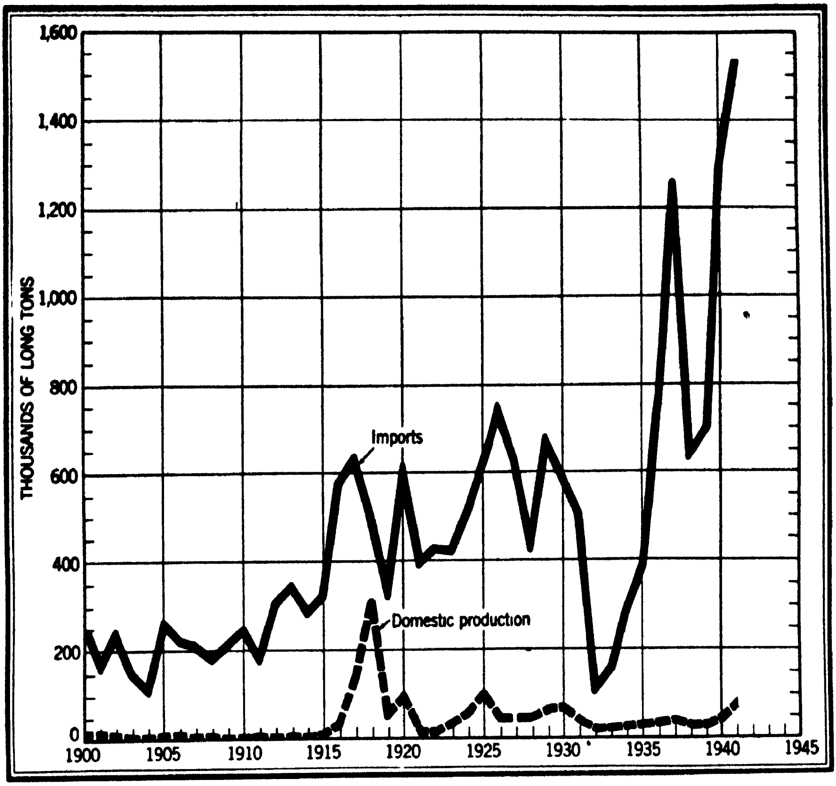

FIGURE 1.—Imports and domestic production (mine shipments) of manganese ore, 1900–1941. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934, data classified as "general imports" were not available, and the figures plotted for 1934–41 represent imports for consumption adjusted for changes in stocks in bonded warehouses and are closely comparable with the record for earlier years.

Government Purchases.—The following schedule regarding Government purchases of manganese ore, effective May 4, 1942, was published by the Metals Reserve Co. The terms are subject to change without notice and do not apply to ores originating outside the limits of continental United States.

1. *Quantity:* One thousand (1,000) to ten thousand (10,000) long tons per contract. Contracts in excess of ten thousand tons may be obtained as a result of individual negotiations, provided reliable and complete engineering data submitted by the applicant warrant a contract for a larger quantity.

2. *Term of Contract:* Deliveries must be completed within eighteen (18) months of the date of contract. If delivery of twenty percent (20%) of the tonnage contracted for has not been made within 6 months of date of contract, Buyer may cancel contract forthwith.

3. *Quality:* Purchases of domestic manganese ores are of three grades with the following specifications:

(*a*) *Black oxide ores:* The schedule of prices and the terms and conditions herein refer to black oxide ores of manganese.

(*b*) *Concentrates:* Manganese concentrates to be acceptable under this schedule must be nodulized or sintered.

(*c*) *Carbonate ores:* Manganese carbonate ores will be accepted under this schedule only if calcined.

		"High-Grade"	"Low-Grade A"	"Low-Grade B"
Manganese	Minimum	48.0 %	44.0 %	40.0%.*
Alumina	Maximum	6.0 %	10.0 %	No maximum.
Iron	Maximum	7.0 %	10.0 %	No maximum.
Phosphorus	Maximum	.18%	.30%	0.50%.
Silica	Maximum	10 0 %	15.0 %	No maximum.
Zinc	Maximum	1.0 %	1.0 %	1.0%.

* Under "Low-Grade B," manganese ore will be accepted to 35.0% minimum under penalties hereinafter prescribed.

Size of ore: None in excess of 12 inches and not more than 25% to pass a 20-mesh screen.

Buyer may reject any shipment which does not conform to the applicable requirements and specifications as set forth above.

4. *Price:* Effective May 4, 1942, contracts will be considered on the following schedule for domestic ores, within continental United States (excluding Alaska); all prices per long ton (2,240 pounds) of dry weight, f. o. b. cars at stock pile designated by Buyer.

"High-Grade"—Base price, $48.00 per long dry ton for ore containing 48.0% manganese with an increase of one dollar ($1.00) per ton for each unit (22.4 pounds) in excess of 48.0%; fractions prorated. "High-Grade" ore containing not less than 48.0% manganese but otherwise falling below specifications but within the limits hereinafter set forth will be accepted subject to the following penalties:

Iron—Up to 10.0% maximum with a penalty of 1¢ per unit for each percent in excess of 7.0%; fractions prorated;

Silica—Up to 15.0% maximum with a penalty of 1¢ per unit for each percent in excess of 10.0%; fractions prorated;

Alumina—Up to 10.0% maximum with a penalty of 1¢ per unit for each percent in excess of 6.0%; fractions prorated;

Phosphorus—Up to 0.30% maximum with a penalty of 1¢ per unit for each 0.03% in excess of 0.18%; fractions prorated.

"Low-Grade A"—Base price, $35.20 per long dry ton for ore containing 44.0% manganese with an increase of eighty cents ($0.80) per ton for each unit (22.4 pounds) in excess of 44.0%; fractions prorated.

"Low-Grade B"—Base price $26.00 per long dry ton for ore containing 40.0% manganese with an increase of sixty-five cents ($0.65) per ton for each unit (22.4 pounds) in excess of 40.0%; fractions prorated. Ore containing a minimum of 35.0% manganese will be accepted under this schedule with a penalty of $1.30 per ton for each unit (22.4 pounds) less than 40.0%; fractions prorated.

In addition to the above prices, an allowance will be made for each long ton shipped equal to the freight tariff per long ton from Seller's nearest convenient rail station to Buyer's stock pile.

The cost of sampling and analysis by the Buyer, weighing, and unloading onto stock pile will be for the account of Buyer.

Under the contract, each lot will be priced under the grade within which the specifications fall. Thus a lot carrying 45% manganese but also 0.50% phosphorus would be priced as "Low-Grade B."

5. *Shipment and Delivery:* Seller will give such advice regarding shipment and arrival as Buyer may require at least ten days prior to shipment of the ore from point of loading onto railroad cars; otherwise, any demurrage at the stock pile will be for Seller's account.

Shipment will be made in flat-bottom gondolas, if available, in lots of not less than one carload, to the stock pile designated by Buyer. Seller will prepay the freight to such stock pile, where the ore will be weighed in cars, light and loaded, on track scales, and sampled for moisture. The lot will be sampled as unloaded and upon receipt of analysis, Buyer will advise Seller as to whether the ore is acceptable and under what classification.

If the lot is ascertained to be unacceptable under the above specifications, Seller will not be entitled to any allowance for prepaid freight and will be held responsible for the removal of this shipment of ore from the stock pile location. Upon failure so to remove the ore within fifteen days of due notice, Buyer may, at its absolute discretion, remove such ore and the cost of such removal shall be for Seller's account; or Buyer may, at its option, otherwise dispose of such ore without

any liability therefor. In the event that Seller fails to repay Buyer for the cost of removal within fifteen days after notice, Buyer may cancel the contract forthwith.

6. *Payment:* As soon as moisture and analysis determinations are received, Buyer will promptly pay Seller in accordance with the weight certificate and the above schedule.

7. *Weights:* The weight paid for will be net railroad track scale weights (weight of loaded car less weight of empty car), less moisture as determined by standard practice.

8. *Sampling and Analysis:* Each lot will be sampled at the time of unloading onto stock pile by a sampler designated by Buyer, three samples being taken, one for each Seller, Buyer, and Umpire, and analysis made for manganese and other guaranteed elements. Usual provisions will be made for splitting limits and settlement by average of Seller's and Buyer's analyses, or by trade practice if samples are sent to Umpire. Moisture samples will be taken in accordance with standard practice. Seller may have representative at sampling at his own expense.

9. *Application for Contract:* Forms may be obtained upon request from the Metals Reserve Co., 811 Vermont Avenue, NW., Washington, D. C. All the information called for on the application form must be supplied before consideration can be given to granting a contract.

Safety.—With increased activity of manganese ore operations, attention is called to the toxic effect of breathing dust containing appreciable quantities of manganese. In 1941 a study was made by Flinn and others[2] of this hazard. An abstract of this work follows:

The occurrence of chronic manganese poisoning among the 34 employees of a manganese ore-crushing mill was found to vary with the atmospheric manganese concentration and with the length of employment. Eleven cases were found. None of the 9 men exposed to less than 30 mg. of manganese per cubic meter was found to have the disease although only 2 of these 9 men had been employed more than 3 years; on the other hand, 5 of the 6 men exposed for more than 3 years to atmospheric manganese concentrations exceeding 90 mg. per cubic meter were found to have the disease. Tests made in a modern mill showed that the workers' exposure could be reduced to at most 6 mg. per cubic meter by the use of enclosed machinery, mechanical conveyors, and exhaust ventilation.

The disease is characterized by muscular incoordination which becomes evident first in the form of difficulty in walking. Later, many parts of the body may be affected and disability results. Most of the usual laboratory tests applied to blood, urine, and cerebrospinal fluid gave normal results. However, manganese-affected workers had low leucocyte counts, particularly in neutrophilic cells, and in Lange's test the middle range of dilutions of cerebrospinal fluid gave slightly positive reactions.

Recommendations for medical and engineering control are incorporated.

DOMESTIC PRODUCTION[3]

The following table shows the various types of manganiferous materials shipped by domestic producers during 1937 to 1941.

Manganiferous raw materials shipped by producers in the United States, 1937–41, in long tons

Year	Metallurgical ore (ferrous metallurgy only)				Battery ore	Miscellaneous manganese ore
	Manganese ore (35 percent or more Mn)	Ferruginous manganese ore (10 to 35 percent Mn)	Manganiferous iron ore (5 to 10 percent Mn)	Manganiferous zinc residuum		
1937	26,419	151,955	1,189,017	115,998	6,447	7,375
1938	16,989	33,620	275,240	39,079	4,959	3,373
1939	18,580	239,544	469,703	129,238	7,767	2,960
1940	27,158	320,006	816,541	154,455	9,271	3,694
1941	65,939	457,287	820,290	251,829	10,178	2,271

[2] Flinn, Robert H., Neal, Paul A., Reinhart, Warren H., Dallavalle, J. M., Fulton, William B., M. D., and Dooley, Allan E., Chronic Manganese Poisoning in an Ore-Crushing Mill: Public Health Service, Public Health Bull. 247, 1941, p. vii.

[3] Throughout chapter, unless otherwise indicated, percentages expressing manganese content of ores refer to ores in natural (undried) state.

Shipments of the various grades of manganese ore during the last 5 years are given, by States, in the following tables. In addition, battery-grade ores were produced in Arizona, California, and Montana; manganiferous zinc residuum was produced from New Jersey zinc ores; and miscellaneous manganese ores came from Alabama, California, Georgia, Montana, Tennessee, Virginia, and West Virginia.

Metallurgical manganese ore shipped from mines in the United States, 1937–41, by States, in long tons

State	1937	1938	1939	1940	1941	State	1937	1938	1939	1940	1941
Alabama	31	111	103	57	------	North Carolina	------	------	43	------	31
Arizona	------	------	------	311	884	Oklahoma	------	------	------	------	36
Arkansas	3,931	2,987	5,365	6,079	4,478	Oregon	------	------	------	------	76
California	------	------	------	158	2,321	Tennessee	1,214	3,603	7,306	6,983	3,923
Colorado	------	------	------	224	170	Texas	38	------	------	------	------
Georgia	689	3,058	2,646	3,572	4,369	Utah	32	------	50	27	38
Idaho	------	------	------	------	30	Virginia	952	1,314	475	1,043	4,449
Missouri	------	------	------	------	11	Washington	------	------	10	------	1,418
Montana	16,854	5,300	2,243	8,230	38,888	West Virginia	1,800	56	------	219	2,195
Nevada	------	------	------	210	2,622						
New Mexico	878	560	339	45	------		26,419	16,989	18,580	27,158	65,939

Ferruginous manganese ore shipped from mines in the United States, 1937–41, by States, in long tons

State	1937	1938	1939	1940	1941	State	1937	1938	1939	1940	1941
Alabama	279	356	519	342	------	Nevada	533	------	------	4,613	7,958
Arizona	------	------	------	------	15	New Mexico	18,581	6,093	31,999	36,835	58,467
Arkansas	7,509	3,477	1,970	1,075	3,019	North Carolina	------	------	51	190	155
California	------	------	------	87	414	Oklahoma	------	------	------	------	50
Colorado	11,577	655	7,516	3,303	------	Tennessee	902	456	294	2,327	1,665
Georgia	4,045	2,807	7,156	10,088	5,996	Utah	3,436	------	262	2,102	492
Idaho	------	------	163	313	348	Virginia	1,170	1,670	4,584	4,482	3,906
Massachusetts	------	230	649	1,900	4,000	Washington	------	------	------	------	6
Michigan	------	------	------	------	------	West Virginia	------	------	------	------	400
Minnesota	84,263	17,424	182,260	248,732	365,942						
Montana	19,660	452	2,121	3,617	4,454		151,965	33,620	239,544	320,006	457,287

Manganiferous iron ore shipped from mines in the United States, 1937–41, by States, in long tons

State	1937	1938	1939	1940	1941
Alabama	149	------	------	------	------
Georgia	5,492	------	------	205	1,064
Michigan	9,739	16,057	------	18,617	------
Minnesota	1,173,637	259,183	469,703	797,642	819,226
Virginia	------	------	------	77	------
Wisconsin	------	------	------	------	------
	1,189,017	275,240	469,703	816,541	820,290

Manganese and manganiferous ores shipped by mines in the United States in 1941, by States

	Ore containing 35 percent or more Mn				Ore containing 10 to 35 percent Mn				Ore containing 5 to 10 percent Mn			
		Long tons				Long tons				Long tons		
	Shippers	Gross weight	Manganese content	Value	Shippers	Gross weight	Manganese content	Value	Shippers	Gross weight	Manganese content	Value
Metallurgical:												
Arizona	11	884	390	$17,141	1	15	5	(1)				
Arkansas	3	4,478	1,917	113,125	3	3,019	803	$44,890				
California	7	2,321	1,060	54,625	2	414	133	(1)				
Colorado	2	170	66	(1)								
Georgia	[2] 7	4,369	1,764	107,074	11	5,996	1,251	42,713	1	1,064	58	(3)
Idaho	1	30	14	(1)	3	348	92	2,046				
Massachusetts					1	4,000	746	(1)				
Minnesota					3	365,942	46,197	1,106,011	4	819,226	56,530	[3] $1,953,798
Missouri	1	11	4	(1)								
Montana	[4] 1	38,888	23,036	(1)	1	4,454	1,405	(1)				
Nevada	2	2,622	986	(1)	2	7,958	2,419	(1)				
New Mexico					3	58,467	7,454	219,401				
North Carolina	1	31	12	(1)	1	155	47	(1)				
Oklahoma	1	36	14	(1)	1	50	6	(1)				
Oregon	1	76	35	(1)								
Tennessee	[2] 9	3,923	1,558	85,771	4	1,665	443	12,229				
Utah	1	38	14	(1)	6	492	100	2,940				
Virginia	[2] 21	4,449	1,832	100,466	7	3,906	702	33,635				
Washington	1	1,418	700	(1)	1	6	1	(1)				
West Virginia	1	2,195	891	(1)	1	400	92	(1)				
Undistributed				1,680,731				283,053				
Total metallurgical	71	65,939	34,293	2,158,933	51	457,287	61,896	1,746,918	5	820,290	56,588	1,953,798
Battery:												
Arizona	1	20	8									
California	1	976	383	485,155								
Montana	[4] 3	9,182	4,082									
Total battery	5	10,178	4,473	485,155								
Miscellaneous:												
Alabama	3	165	60	2,736								
California	2	360	168									
Georgia	[2] 2	74	31	24,183								
Montana	[4] 2	649	245									
West Virginia	1	5	2									
Tennessee	[2] 4	29	11	420								
Virginia	[2] 11	989	394	24,697								
Total miscellaneous	25	2,271	911	52,036								
	91	78,388	39,677	2,696,124	51	457,287	61,896	1,746,918	5	820,290	56,588	1,953,798

[1] Included under "Undistributed."
[2] 1 producer in Georgia, 2 in Tennessee, and 5 in Virginia shipped both metallurgical and miscellaneous ore.
[3] Value for Georgia included with Minnesota.
[4] 1 producer in Montana shipped metallurgical, battery-grade, and miscellaneous ore.

Alabama.—Production in Alabama was small during 1941, and all was miscellaneous-grade ore. Three producers, one each in Cherokee, Etowah, and Jefferson Counties, supplied the total of 165 long tons.

Arizona.—Norman W. McGregor shipped a small quantity of battery-grade ore averaging 41.6 percent manganese from the Black Warrior mine in Mohave County. The largest shipper from Arizona during 1941 was Apache Mines, Inc., with operations at the Apache mines in Gila County and the Casa Grande mine in Pinal County. Shipments averaged 44.4 percent manganese. In addition, small quantities were shipped by 10 other producers in Cochise, Coconino, Gila, Pinal, Yavapai, and Santa Cruz Counties.

Arkansas.—Most of the manganese ore from Arkansas in 1941 came from the Batesville-Cushman district of Independence County and was supplied by the Walter H. Denison Manganese & Contracting Co., Inc., and the Arkansas Manganese Co. The North American Manganese Corporation made an initial shipment of metallurgical ore from Pike County in western Arkansas; this ore averaged 48.69 percent manganese (dry).

A study of the beneficiation of manganese wad ores from Batesville, Ark., has been made by Shelton and coworkers.[4]

California.—A great increase in manganese-mining activity was apparent in California during 1941. Manganese ore was shipped by 10 producers in 7 counties compared with only 2 producers in 1940. Shipments during 1941 were reported from Imperial, Plumas, San Bernardino, San Joaquin, Santa Clara, Stanislaus, and Trinity Counties. William Clark Crittendon shipped 976 tons of battery-grade ore from the Black Wonder-Jones mines in Stanislaus County. In addition, 414 tons of ferruginous manganese ore were shipped from Santa Clara and Trinity Counties during the year.

Colorado.—J. D. Thomas at Iola and Strategic Minerals, Inc., in San Miguel County supplied the State total of 170 tons of metallurgical-grade ore during 1941.

Georgia.—All ore containing 35 percent or more manganese and nearly all other manganese-bearing ores shipped from Georgia in 1941 came from Bartow County. Small quantities of ferruginous manganese ore were shipped from Fannin and Polk Counties. Bearden & Mosteller shipped 1,064 tons of manganiferous ore from the Cartersville district. Miscellaneous ores were shipped by Bearden & Mosteller and the Manganese Mining Co., both of Cartersville.

A study of the concentration of these ores was made by Johnston and coworkers.[5]

Idaho.—The Metalloy Corporation, Cleveland, Idaho, made the only shipment of manganese ore made from Idaho in 1941—that from the Hot Spot mine. Three producers shipped a total of 348 tons of ferruginous manganese ore during the year.

Massachusetts.—Anson G. Betts shipped ferruginous manganese ore averaging 20 percent manganese from the Taconic mine in Hampshire County.

Minnesota.—Ferruginous manganese ore averaging 12.62 percent manganese was shipped from the Alstead-Hillcrest, Louise, and Merritt mines. Manganiferous iron ore averaging 6.90 percent manganese

[4] Shelton, S. M., Fine, M. M., and Bardill, J. D., Beneficiation of Manganese Wad Ores from the Chinn Property, Batesville, Ark. Bureau of Mines Rept. of Investigations 3614, 1942, pp. 1–18.

[5] Johnston, T. L., Fine, M. M., and Shelton, S. M., Concentration of Manganese-Bearing Ore from the Dobbins Mine, Cartersville, Ga.: Bureau of Mines Rept. of Investigations 3608, 1942, pp. 1–32.

came from the Louise, Merritt, Sagamore, and Mahnomen mines. All shipments during 1941 came from the Cuyuna Range in Crow Wing County.

A study of the production of ferromanganese-grade concentrates from these ores has been made by Shelton and Fine.[6]

Missouri.—Ernest Pearce shipped a small quantity of metallurgical-grade ore from Washington County during 1941.

Montana.—Sixty-two percent of the total United States production of manganese ore during 1941 came from Montana. The bulk of the battery-grade ore came from the Philipsburg district and averaged about 70 percent MnO_2; however, several cars of battery-grade ore were shipped from the Emma mine near Butte. A total of 4,454 tons of ferruginous manganese ore was shipped from the Trout mine in the Philipsburg district. The Anaconda Copper Mining Co. at Butte shipped 59 percent of the United States total of metallurgical manganese ore in 1941 and was the most important development of the year from a standpoint of tonnage produced; shipments of calcined nodules from Anaconda were begun in June in fulfillment of its contract with the Metals Reserve Co. The concentration process is described by Huttl [7] and consists of selective flotation, which recovers manganese, lead, zinc, and silver. The rhodochrosite nodules are calcined before shipment.

Deposits of the Philipsburg district are described in detail by Goddard.[8]

Nevada.—H. E. Chatwin and R. H. Richards shipped 2,622 tons of metallurgical ore averaging 37.6 percent manganese and 7,958 tons of ferruginous manganese ore from the Black Diablo mine in Humboldt County and the Black Rock mine in Lander County.

New Mexico.—No shipments of manganese ore were made from New Mexico in 1941. The Luna Manganese Co. of Deming produced about 250 tons of concentrates, which were shipped early in 1942. The Luck Mining & Construction Co. shipped the bulk of the ferruginous manganese ore from the Boston Hill mine in Grant County.

Lasky [9] has described manganese deposits in the Little Florida Mountains, Luna County, and De Vaney and coworkers [10] have studied the concentration of ores from that district.

North Carolina.—The National Metals Corporation shipped 31 tons of metallurgical ore from the Bald Knob mine in Alleghany County, and ferruginous manganese ore was shipped from McDowell County.

Oklahoma.—Robert Galbreath shipped metallurgical ore and ferruginous manganese ore from Coal and Johnston Counties.

Oregon.—Seventy-six tons of manganese ore averaging 46.67 percent manganese were shipped from the McAdams property in Coos and Curry Counties during 1941.

South Dakota.—No production of manganese-bearing ore in 1941 for commercial purposes was reported from South Dakota. How-

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[6] Shelton, S. M., and Fine, M. M., Progress Reports—Metallurgical Division. 49 Ferromanganese-Grade Concentrates from the Cuyuna Range: Bureau of Mines Rept. of Investigations 3582, 1941, 14 pp.

[7] Huttl, John B., Domestic Manganese from Butte Helps in Emergency: Eng and Min. Jour., vol. 143, No. 1, 1942, pp. 56–58.

[8] Goddard, E. N., Manganese Deposits at Philipsburg, Granite County, Mont.: Geol. Surv. Bull. 922-G, 1940, pp. 157–204.

[9] Lasky, S. G., Manganese Deposits in the Little Florida Mountains, Luna County, N. Mex Geol. Surv. Bull. 922-C, 1940, pp. 55–73.

[10] De Vaney, F. D., Fine, M. M., and Shelton, S. M., Manganese Investigations—Metallurgical Division. 6. Ore-Dressing Studies of Manganese Ores. Concentration of Manganese Ores from the Little Florida Mountains, Luna County, N. Mex.: Bureau of Mines Rept. of Investigations 3620, 1942, 9 pp.

ever, the Bureau of Mines has done extensive work on the concentration of nodules and recovery of manganese from the manganiferous shales near Chamberlain in south-central South Dakota. This is one of the most extensive of our possible sources of manganese. Gries and Rothrock [11] estimate the manganese content of the deposit to be as high as 850,000,000 tons and state that it is safe to assume that at least 50,000,000 tons of nodules can be recovered from the areas free of overburden and suitable for open-pit mining.

De Vaney and coworkers [12] have studied concentration of manganese nodules from Chamberlain, and Wood and coworkers [13] recovery of manganese from nodules.

Tennessee.—Manganese-bearing ores were shipped from Johnson, Unicoi, and Washington Counties during 1941. The Embree Iron Co., Unicoi County, and the Interstate Manganese Co., Johnson County, shipped the bulk of the total ore—from the Embree and Greer mines.

Reichert [14] has recently given a detailed description of the manganese resources of East Tennessee, and Johnston and coworkers [15] have studied the concentration of Tennessee ores.

Utah.—F. W. De Friess made Utah's only shipment of manganese ore, from a mine near Green River in Grand County. Ferruginous manganese ore was shipped from six properties in Grand, Juab, Kane, and Sevier Counties.

Zimmerley and coworkers[16] have studied concentration of Drum Mountain ores.

Virginia.—Twenty-one shippers of metallurgical-grade ore and 11 shippers of miscellaneous ore (5 shipping both grades) supplied 4,449 tons of metallurgical and 989 tons of miscellaneous ore during 1941. Shipments of manganese ore were made from Appomattox, Augusta, Bath, Bland, Campbell, Craig, Frederick, Giles, Grayson, Page, and Smyth Counties. In addition, 3,906 tons of ferruginous manganese ore were shipped from Augusta, Bland, and Giles Counties during the year.

Washington.—The Sunshine Mining Co. shipped 1,418 tons of manganese ore containing 49.34 percent manganese from the Crescent mine in Clallam County during 1941. A very small shipment of ferruginous manganese ore was shipped from the Stevens Creek mine in Grays Harbor County.

West Virginia.—The Appalachian Ores Co. shipped 2,195 tons of metallurgical ore and 400 tons of ferruginous manganese ore from the Sweet Springs mine in Monroe County. Five tons of miscellaneous ore were shipped from a mine in Pendleton County.

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[11] Gries, J. P., and Rothrock, E. P., Manganese Deposits of the Lower Missouri Valley in South Dakota: South Dakota State Geol Survey Rept. of Investigations 38, 1941, 96 pp.

[12] De Vaney, F. D., Shelton, S. M., and Lamb, F. D., Manganese Investigations—Metallurgical Division. 3 Ore-Dressing Studies of Manganese Ores. Concentration of Manganese Nodules from Chamberlain, S Dak. Bureau of Mines Rept. of Investigations 3613, 1942, 21 pp.

[13] Wood, C. E., Wallfred, C. L., Barrett, E. P., Reader, L. J., Ginsberg, S. I., Wyman, W. F., and Evans, R. L., Manganese Investigations—Metallurgical Division 2. Hydrometallurgical Studies of Manganese Ores. Recovery of Manganese from Chamberlain Nodules by the Reyerson Modification of the Sulfur Dioxide Leaching Process Bureau of Mines Rept. of Investigations 3609, 1942, 30 pp.

[14] Reichert, Stanley O., Manganese Resources of East Tennessee: State of Tenn. Division of Geol., Nashville, Tenn., Bull. 50, 1942, 205 pp.

[15] Johnston, T. L., Shelton, S. M., Fine, M. M. and Calhoun, W. A., Manganese Investigations—Metallurgical Division. 10. Ore-Dressing Studies of Manganese Ores. Concentration of Manganese-Bearing Ore from the Interstate Manganese Co., Johnson County, Tenn.: Bureau of Mines Rept. of Investigations 3623, 1942, 13 pp.

[16] Zimmerley, S. R., Vincent, J. D., and Schock, C. H., Manganese Investigations—Metallurgical Division. 1. Ore-Dressing Studies of Manganese Ores. Concentration of Manganese Ores from the Drum Mountain District, Utah: Bureau of Mines Rept. of Investigations 3606, 1942, 12 pp.

IMPORTS OF MANGANESE ORE

Imports for consumption of manganese ore containing 35 percent or more manganese increased 19 percent in 1941 over 1940 and comprised 1,498,667 long tons of metallurgical ore containing 719,096 tons of manganese valued at $24,165,221 and 32,209 tons of battery-grade ore containing 17,472 tons of manganese valued at $920,610. All supplying countries except Gold Coast and U. S. S. R. made larger shipments than in 1940; the most noticeable increases came from Brazil, Cuba, British India, and Union of South Africa, and these four countries supplied 80 percent of the total in 1941. Of the battery-grade ore, 25,347 tons came from Gold Coast, 4,574 tons from Union of South Africa, 2,090 tons from Netherlands Indies, 139 tons from Mexico, 57 tons from British India, and 2 tons from Canada.

General imports (containing 35 percent or more manganese), which represent the movement of ore into this country, were 9 percent less than imports for consumption and totaled 1,394,762 long tons containing 654,710 tons of manganese. Of this ore 387,348 tons came from Brazil, 322,241 tons from British India, 261,374 tons from Union of South Africa, and 243,405 from Cuba; and these four countries supplied 87 percent of the total in 1941. Included in the total ore are receipts of battery-grade ore amounting to 28,995 tons (containing 15,840 tons of manganese), of which Gold Coast supplied 22,804 tons, or 79 percent.

No imports for consumption of ferruginous manganese ore (containing 10 to 35 percent manganese) were recorded during 1941. Imports of manganiferous ore (5 to 10 percent manganese) are estimated at 2,022 tons.

Manganese ore (35 percent or more Mn) imported into the United States, 1940–41, by countries

Country	General imports [1] (long tons)				Imports for consumption [2]					
					Long tons				Value	
	Gross weight		Mn content		Gross weight		Mn content			
	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941
Belgian Congo	970	25,323	485	12,661						
Brazil	221,851	387,348	92,615	164,039	168,241	315,937	75,060	139,920	$1,678,395	$3,367,812
Chile	17,031	17,135	8,112	8,076	7,849	16,344	3,718	7,740	155,680	366,012
Cuba	130,645	243,405	64,175	115,979	130,646	243,405	64,175	115,979	3,059,735	6,353,222
Gold Coast	241,014	67,699	123,709	35,389	246,983	198,907	124,221	101,551	4,468,383	3,224,209
India, British	215,740	322,241	109,284	162,117	189,473	386,908	95,100	196,211	2,323,880	6,270,579
Mexico	447	3,814	271	1,689	447	941	271	460	12,145	26,962
Netherlands Indies	5,245	9,253	2,753	4,933	5,245	8,244	2,753	4,459	144,131	250,463
Philippine Islands	43,515	57,048	21,824	27,498	43,515	57,048	21,824	27,497	627,243	1,000,460
Union of South Africa	238,400	261,374	106,588	122,264	177,739	273,749	78,508	127,534	1,802,537	3,829,070
U. S. S. R	179,251		86,018		311,748	29,183	151,367	15,115	3,947,766	393,370
Other countries	207	122	110	65	193	210	104	102	11,992	3,672
	1,294,316	1,394,762	615,944	654,710	1,282,079	1,530,876	617,101	736,568	18,231,887	25,085,831

[1] Comprises ore received in the United States during year, part went into consumption and remainder entered bonded warehouses

[2] Comprises receipts during year for consumption and ore withdrawn from bonded warehouses during year (irrespective of time of importation).

CONSUMPTION AND STOCKS OF MANGANESE RAW MATERIALS

The following table shows actual consumption of manganese ore (containing 35 percent or more manganese (natural)) and alloys during 1941 and stocks at the end of the year. As this table is the result of the first study of this type conducted by the Bureau of Mines, there are no comparable statistics for earlier years.

Manganese ore and manganese alloys consumed and in stock[1] in the United States in 1941, gross weight in long tons

	Consumed	In stock Dec. 31, 1941 [1]	
		At plant (including bonded warehouses)	In bonded warehouses
Manufacturers of manganese alloys			
Manganese ore			
Domestic			
35 to 47 percent Mn (natural)	16,000	10,309	
Over 47 percent Mn (natural)	94	403	
Foreign	1,097,466	1,017,291	624,692
	1,113,560	1,028,003	624,692
Ferromanganese		34,349	26,118
Spiegeleisen		8,594	
Silicomanganese		1,975	1,304
Manufacturers of iron and steel			
Manganese ore.			
Domestic			
35 to 47 percent Mn (natural)	1,214	1,266	
Over 47 percent Mn (natural)	4,189	1,114	
Foreign	17,174	7,337	
	22,577	9,717	
Ferromanganese	520,054	150,361	2,983
Spiegeleisen	144,120	65,328	
Silicomanganese	41,294	5,671	
Manufacturers of dry cells			
Manganese ore			
Domestic			
35 to 47 percent Mn (natural)	3,618	433	
Over 47 percent Mn (natural)	6,777	2,707	
Foreign	23,520	20,933	14,021
	33,915	24,073	14,021
Brokers and dealers			
Manganese ore Foreign		8,820	2,539
Ferromanganese		83	
Grand total			
Manganese ore			
Domestic			
35 to 47 percent Mn (natural)	20,832	12,008	
Over 47 percent Mn (natural)	11,060	4,224	
Foreign	1,138,160	1,054,381	641,252
	1,170,052	1,070,613	641,252
Ferromanganese	520,054	184,793	29,101
Spiegeleisen	144,120	73,922	
Silicomanganese	41,294	7,646	1,304

[1] Exclusive of Government stocks.

The following table shows ores available for consumption in the United States during 1941. The table does not consider consumers or Government stocks at beginning and end of the year.

Indicated consumption of manganiferous raw materials in the United States in 1941

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Long tons	Mn content (percent)	Long tons	Mn content (percent)	Long tons	Mn content (percent)
Domestic shipments	78,388	50.6	709,116	15.4	820,290	6.9
Imports for consumption	1,530,876	48.1	-	-	[1] 2,022	7.2
Total available for consumption	1,609,264	48.2	709,116	15.4	822,312	6.9

[1] Estimated.

In addition to the foregoing, 1,592,700 long tons of domestic ore containing 2 to 5 percent manganese were shipped from mines in 1941, and presumably used in the manufacture of pig iron, compared with 737,400 tons in 1940 and 652,900 tons in 1939. Figures for imports of ore of this class are not available.

METALLURGICAL INDUSTRY

Although manganese is used in both the ferrous and nonferrous metallurgical industries, the bulk is consumed in the manufacture of iron and steel. Most of the ore entering the industry is used in the manufacture of ferromanganese and spiegeleisen, the forms in which manganese ordinarily is added to steel.

Ferromanganese and spiegeleisen imported into and made from domestic and imported ores in the United States, 1940–41, in long tons

	1940		1941	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	10,369	8,573	6,278	5,085
Domestic production	459,538	365,092	518,486	412,088
From domestic ore [1]	7,306	5,773	19,577	15,888
From imported ore [1]	452,232	359,319	498,909	396,200
Total	469,907	373,665	524,764	417,173
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		1.54		3.81
Number of plants making ferromanganese			12	--
Spiegeleisen:				
Imported	15,585	[1] 3,117	4,233	[1] 847
Domestic production	101,892	20,805	158,853	25,606
From domestic ore [1]	101,820	20,794	156,735	25,265
From imported ore [1]	72	11	2,118	341
Total	117,477	23,922	163,086	26,453
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		86.92		95.51
Number of plants making spiegeleisen	5		5	
Total available supply of metallic manganese in ferromanganese and spiegeleisen	--	397,587		443,626
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		2.94		1.34
Ferromanganese made from imported ore		90.38		89.31
Spiegeleisen made from imported ore		(2)		.08
Ferromanganese made from domestic ore		1.45		3.58
Spiegeleisen made from domestic ore		5.23		5.69
Ferromanganese and spiegeleisen made from domestic ore		6.68		9.27
Spiegeleisen made and imported		6.02		5.96
Total open-hearth, Bessemer, and electric steel	59,805,055		73,961,559	-

[1] Estimated.
[2] Less than 0.01 percent.

Ferromanganese.—The domestic output of ferromanganese in 1941, which increased 13 percent over 1940, was produced at the following plants:

Bethlehem Steel Co., Johnstown, Pa.
Carnegie-Illinois Steel Corporation, Etna, Duquesne, and Clairton, Pa.
Electro Metallurgical Co., Alloy, W. Va., and Niagara Falls, N. Y.
E. J. Lavino & Co. Reusens, Va., and Sheridan, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Products Corporation, Rockdale and Rockwood, Tenn.
Keokuk Electro-Metals Co., Keokuk, Iowa.

In addition to the foregoing plants, shipments were made by the Colorado Fuel & Iron Corporation, Pueblo, Colo., and the Jones & Laughlin Steel Corporation, Aliquippa, Pa.

The larger part of the ferromanganese produced in this country is made from foreign ores, as shown in the following table:

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1937–41

Year	Ferromanganese produced			Materials consumed (long tons)				Manganese ore used per ton of ferromanganese made (long tons)
	Long tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Long tons	Foreign	Domestic			
1937	376,443	79.54	299,425	698,052	9,444	17,511	6,017	1.879
1938	242,994	78.65	191,104	416,738	22,548	9,696	8,462	1.808
1939	270,111	79.24	214,040	502,986		8,324	6,250	1.862
1940	459,538	79.45	365,092	871,725	11,981	5,258	6,918	1.923
1941	518,486	79.48	412,088	1,001,953	8,405	4,613	5,385	1.949

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1937–41, by sources of ore, in long tons

Source of ore	1937	1938	1939	1940	1941
Africa	150,112	152,698	129,227	208,366	198,161
Brazil	112,238	64,060	58,284	169,097	293,544
Chile	186		856	5,425	4,210
Cuba	60,012	36,295	58,999	100,767	121,054
India	62,199	55,965	86,309	167,928	[1] 223,594
Mexico					1,567
Philippine Islands				11,400	5,568
U. S. S. R.	313,305	107,720	160,311	167,220	[1] 129,754
Undistributed				41,522	[1] 24,501
	698,052	416,738	502,986	871,725	1,001,953

[1] Tonnage entered under "Undistributed" comprises ore from India and U. S. S. R., separation as to source not reported by consumer.

Shipments of ferromanganese in 1941 increased 23 percent over 1940. The record of shipments during the past 5 years is as follows:

Ferromanganese shipped from furnaces in the United States, 1937–41

Year	Long tons	Value	Year	Long tons	Value
1937	359,842	$30,696,748	1940	449,367	$42,755,485
1938	223,720	19,144,884	1941	553,031	69,378,004
1939	296,631	24,137,211			

Imports for consumption and exports decreased 39 and 65 percent, respectively, in 1941 from 1940. Ferromanganese imported for consumption in 1941 comprised 13 tons containing not over 1 percent carbon and 6,265 tons containing not less than 4 percent carbon.

Ferromanganese imported into and exported from the United States, 1937–41

Year	Imports for consumption			Exports [1]	
	Gross weight (long tons)	Mn content (long tons)	Value	Gross weight (long tons)	Value
1937	29,559	23,888	$2,163,616	1,725	$72,502
1938	26,258	21,118	1,770,948	247	18,799
1939	41,227	33,414	2,935,214	2,923	247,798
1940	10,369	8,573	1,321,369	13,036	1,366,087
1941	6,278	5,085	557,150	4,603	771,575

[1] Includes spiegeleisen; not separately classified prior to July 1, 1941.

Imports of ferromanganese in 1940 and 1941, by countries, are shown in the following table.

Ferromanganese imported for consumption in the United States, 1940–41, by countries

Country	1940		1941	
	Mn content (long tons)	Value	Mn content (long tons)	Value
Canada			1,073	$136,029
Japan	35	$2,349		
Norway	8,538	1,319,020	11	1,597
United Kingdom			4,001	419,524
	8,573	1,321,369	5,085	557,150

Customs districts through which imported ferromanganese entered in 1940 and 1941 are as follows:

Manganese content of ferromanganese imported for consumption in the United States, 1940–41, by customs districts, in long tons

Customs district	1940	1941	Customs district	1940	1941
Buffalo	992	969	New York	529	
Los Angeles	79		Oregon	38	
Maryland	6,731	4,001	Vermont		20
Michigan		95	Washington (State)	47	
New Orleans	157			8,573	5,085

The quoted price of ferromanganese was unchanged throughout 1941, as shown in the following table.

Prices per long ton of ferromanganese in the United States, 1939-41 [1]

[80 percent—delivered at Pittsburgh]

Month	1939	1940	1941	Month	1939	1940	1941
January	$91.58	$105.33	$125.33	July	$85.33	$125.33	$125.33
February	85.33	105.33	125.33	August	85.33	125.33	125.33
March	85.33	105.33	125.33	September	95.33	125.33	125.33
April	85.33	105.33	125.33	October	105.33	125.33	125.33
May	85.33	105.33	125.33	November	105.33	125.33	125.33
June	85.33	105.33	125.33	December	105.33	125.33	125.33

[1] Steel, vol. 110, January 5, 1942.

Spiegeleisen.—Domestic shipments of spiegeleisen in 1941 increased 52 percent over 1940 and 91 percent over 1939.

Spiegeleisen produced and shipped in the United States, 1937-41

Year	Produced (long tons)	Shipped from furnaces		Year	Produced (long tons)	Shipped from furnaces	
		Long tons	Value			Long tons	Value
1937	(1)	134,983	$3,969,822	1940	101,892	106,707	$3,487,565
1938	11,311	24,939	728,830	1941	158,853	161,765	5,793,481
1939	91,491	84,739	2,484,042				

[1] Bureau of Mines not at liberty to publish figures.

Spiegeleisen was manufactured at the following plants during 1941:

Carnegie-Illinois Steel Corporation, Duquesne and Clairton, Pa., and Gary, Ind.
New Jersey Zinc Co., Palmerton, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.

Most of the spiegeleisen produced in the United States is made from domestic raw materials. However, 1,683 tons of Brazilian ore containing 42.14 percent manganese and 143 tons of Cuban ore containing 50.73 percent manganese were consumed in the production of spiegeleisen during 1941. Imports of spiegeleisen for consumption in 1941 decreased 73 percent from 1940. The total supply came from Canada.

Spiegeleisen imported for consumption in the United States, 1937-41

Year	Long tons	Value	Year	Long tons	Value
1937	16,841	$589,766	1940	15,585	$638,732
1938	17,248	625,480	1941	4,233	215,108
1939	38,264	1,329,814			

The prices of spiegeleisen (20 percent) at producers' furnaces, as quoted by Steel, remained constant at $36.00 a ton throughout 1941.

Manganiferous pig iron.—Precise data on the consumption of manganiferous ores in the production of manganiferous pig iron are not available. However, 820,290 long tons of domestic ore containing 5 to 10 percent manganese and 1,592,700 tons containing 2 to 5 percent manganese were shipped during 1941. A small amount of foreign manganiferous iron ore (2,022 tons) and 7,422 tons of foreign ferruginous manganese ore were also consumed in the manufacture of pig iron.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1939–41, in long tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1939	1940	1941	1939	1940	1941
Africa	1,184	184				
Asia. Palestine	1,133	36,069				
Australia				54,941	11,905	2,022
Brazil		746	7,422	6,831		
Sweden				985	523	
Undistributed	582					
	2,899	36,999	7,422	62,757	12,428	2,022

BATTERY INDUSTRY

Shipments of manganese ore from Arizona, California, and Montana by domestic producers to battery makers in 1941 totaled 10,178 long tons. Imports of battery-grade ore for consumption were 32,209 long tons containing 17,472 tons of manganese. Manganese ore for battery use should have a high content of available oxygen with minimum iron and be comparatively free from such metals as arsenic, copper, nickel, or cobalt, which are electronegative to zinc.

MISCELLANEOUS INDUSTRIES

Small quantities of manganese ores are used in the glass, paint and varnish, pigments and dyes, and other miscellaneous industries. No accurate statistics are available to show the amount of manganese ore used for these purposes in this country, but it is known to be very small, probably less than 5,000 tons a year.

PRICES

Prices of manganese ore (except battery ore) are upon a unit basis, the unit being 1 percent of a long ton or 22.4 pounds of contained manganese. Prices of battery-grade ore are quoted upon a per-ton basis, with a minimum requirement of manganese dioxide.

A complete price schedule for domestic ore is given in the early pages of this chapter under "Government Purchases"; effective May 4, 1942, the price rose to $1.00 per unit for 48-percent-grade ore. The average value reported for ore containing 35 percent or more manganese during 1941 was about 63 cents per unit. Quotations on imported ore in the following table are from the Engineering and Mining Journal. A duty of one-half cent per pound of contained manganese is imposed on all imported manganese ore except that from Cuba and the Philippine Islands, which enters duty free.

Domestic prices of metallurgical manganese ore in 1941, in cents per long-ton unit

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

	Beginning of year	End of year		Beginning of year	End of year
Brazilian, 46–48 percent Mn	$0.50	$0.63	Cuban (not dutiable)		
Chilean, 47–48 percent Mn	.52	.65	50–52 percent Mn	$0.65	$0.78
South African, 50–52 percent Mn	.55	.68	45–47 percent Mn	.55	.73

According to the Engineering and Mining Journal, prices for chemical (battery-grade) ores per long ton in carlots at the end of 1941 were as follows: Domestic, containing 70 to 72 percent MnO_2, \$45 to \$50; Brazilian or Cuban, 80 percent MnO_2, \$55; Javan or Caucasian, 85 percent MnO_2, nominal.

WORLD PRODUCTION

Manganese ore produced in principal countries of the world, 1937–41, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	Percent Mn	1937	1938	1939	1940	1941
North America:						
Canada (shipments)		77		359	(2)	(2)
Costa Rica		100	304	(2)	(2)	(2)
Cuba	36–50+	131,299	123,844	102,415	119,852	191,937
Mexico	40+	17	117	27	307	979
United States:						
Continental (shipments)	35+	40,887	25,727	29,777	40,767	79,646
Puerto Rico (exports)	48–51	2,381	1,039			
South America:						
Argentina [3]	35–38	606	437	651	710	1,476
Bolivia (exports)	50			500	(2)	(2)
Brazil	38–50	262,409	306,025	257,752	313,391	[4] 437,402
Chile	40–50	13,014	19,319	12,550	11,620	[4] 21,396
Peru		157	24	96	283	(2)
Europe:						
Bulgaria	30–45	3,000	1,887	944	2,000	(2)
Germany	30+	226	163	(2)	(2)	(2)
Greece	30+	6,952	7,075	11,178	(2)	(2)
Hungary	35–48	25,088	22,221	(2)	(2)	(2)
Italy	34–37	33,532	48,282	(2)	(2)	(2)
Portugal	40+	317	557	225	1,059	(2)
Rumania	30–36	50,749	60,256	41,546	(2)	(2)
Spain		[5] 490	[5] 1,319	(2)	(2)	[6] 7,277
Sweden	30–50	5,845	5,347	5,934	(2)	(2)
U. S. S. R.	41–48	2,752,000	2,272,800	(2)	2,800,000	[7] 3,000,000
Yugoslavia	32–38	4,420	3,759	5,655	(2)	(2)
Asia:						
China (exports)	45–46	51,446	1,247	1	(2)	(2)
India:						
British	47–52	1,068,472	983,464	858,220	(2)	[7] 1,000,000
Portuguese	42–50+	4,077	9,478	8,204	6,525	(2)
Indochina		5,287	2,214	2,440	[7] 2,000	(2)
Japan	49–51	[7] 70,000	[7] 80,000	(2)	(2)	(2)
Netherlands Indies	50–55	11,083	9,687	12,074	11,569	(2)
Philippine Islands	45–50	25,518	58,143	29,394	52,166	[8] 33,664
Turkey	30–50	530	2,186	3,339	(2)	(2)
Unfederated Malay States	30	33,319	32,483	31,952	11,702	(2)
Africa:						
Belgian Congo	56	27,471	7,725	(2)	18,369	(2)
Egypt	30+	186,320	153,112	119,882	64,912	[7] 200,000
Gold Coast (exports)	50+	535,495	329,411	341,710	(2)	(2)
Morocco:						
French	40–50+	76,460	86,597	(2)	(2)	(2)
Spanish	38	660	152	(2)	(2)	(2)
Northern Rhodesia	30–48	2,379	2,779	3,018	(2)	(2)
Union of South Africa	30–51	631,194	551,739	419,697	412,071	[9] 223,093
Oceania:						
Australia:						
New South Wales		109	221	(2)	(2)	(2)
Queensland		1,052	382	(2)	(2)	(2)
South Australia				7	(2)	(2)
New Zealand		5	91	494	996	(2)
		6,064,000	5,212,000	(2)	(2)	(2)

[1] In addition to countries listed, Belgium produces manganese ore, but data of output are not available. Czechoslovakia reports a production of manganese ore, but as it has been ascertained that the product so reported averages less than 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table.
[2] Data not available.
[3] Shipments by rail and river.
[4] Exports.
[5] Salable.
[6] January to October, inclusive.
[7] Estimated.
[8] Exports January to June, inclusive.
[9] January to June, inclusive.

Brazil.—Production of manganese ore in Brazil increased greatly in 1941 over 1940. Exports totaled 437,402 metric tons compared with 270,000 tons in 1940. Nearly all the exports came to the United States, which imported 393,565 metric tons in 1941. Brazil was the largest supplier of manganese ore imported into the United States during the year. Stocks on hand in Rio de Janeiro on December 31, 1941, were 32,010 metric tons compared with 68,212 tons at the end of 1940. During the first quarter of 1942, all exports from Brazil came to United States.

Chile.—Exports from Chile totaled 21,396 metric tons in 1941 compared with 19,518 tons in 1940; 17,409 metric tons reached the United States during 1941.

Cuba.—A concentrating plant at Cristo near Santiago, Cuba, was expanded 30 percent to make possible a production of 130,000 tons of high-grade ore during 1941. A considerable quantity of ore was purchased from small producers to make this production possible. Total Cuban production in 1941 was 191,937 metric tons.

Mexico.—Production of manganese ore in Mexico was 979 metric tons in 1941 compared with 307 tons in 1940.

Philippine Islands.—Exports of manganese ore from the Philippines were 33,664 metric tons for the first 6 months of 1941 compared with 58,038 tons during entire year 1940.

U. S. S. R.—Output in U. S. S. R., the world's largest producing nation, was reported by official sources to have been 2,800,000 metric tons in 1940. It is estimated that production totaled 3,000,000 tons in 1941; no manganese was exported to the United States in 1941.

CHROMITE

By Frederick Betz, Jr.

SUMMARY OUTLINE

GENERAL FEATURES IN 1941

The outstanding features of the chromite industry during 1941 were the continued increase in imports of foreign ore and the expansion of the Government program for purchasing domestic chromite. Mines in the United States shipped 12,731 long tons of chromite (ore and concentrates), a peak in annual shipments for the period since 1918 (see historic table under "Consumption" and fig. 1). The apparent available supply soared to an all-time high of 1,008,507

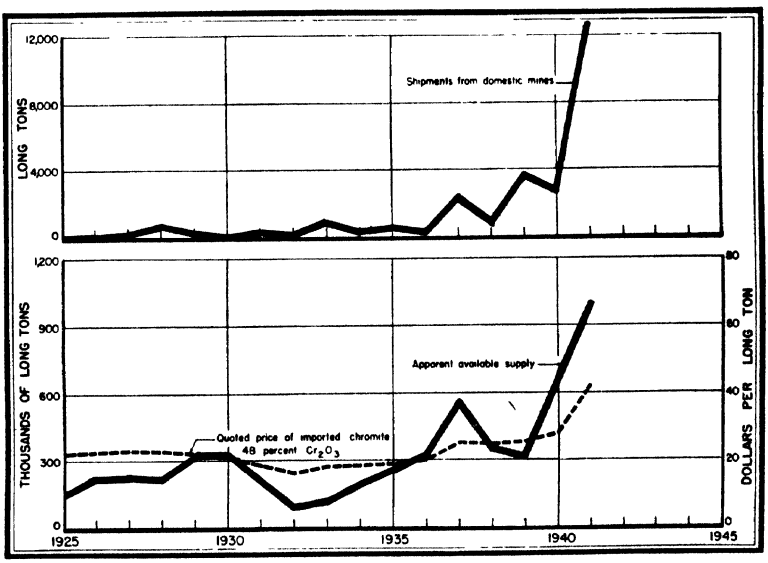

FIGURE 1.—Trends in shipments, prices, and apparent available supply of chromite, 1925–41.

long tons. Large increases were noted in imports from Africa, Cuba, the Philippine Islands, and New Caledonia, whereas shipments to the United States from British India, Greece, and Turkey declined. Statistics on world production are incomplete for 1940 and 1941. Latest figures show that production decreased from 1,155,000 long tons in 1939 to 1,123,000 tons in 1940. In 1941 an increase is indicated, largely because of the rise in exports from Cuba and the Philippine Islands. In the United States, the Government continued its exploration and development work on chromite deposits through the Bureau of Mines and the Geological Survey. The Office of Production Management placed restrictive orders on chromium, which culminated in a complete allocation system. The Metals Reserve Co. established purchasing schedules for domestic ore in November and December to encourage chromite mining in the United States.

Salient statistics of the chromite industry in the United States, 1925–29 (average) and 1937–41

	1925–29 (average)	1937	1938	1939	1940	1941
Apparent available supply						
Imports ....long tons	224, 357	553, 916	352, 085	317, 511	657, 689	995, 776
Shipments from domestic mines long tons	276	2, 321	812	3, 614	2, 662	12, 731
	224,633	556,237	352,897	321,125	660,351	1,008,507
Imports.						
Africa [1] .... percent of total	63	50	48	37	43	43
Cuba ....do	15	17	11	21	8	16
Greece ....do	9	5	3	3	2	(2)
New Caledonia ....do	6	9	8	5	6	8
Philippine Islands ....do	....	8	22	23	24	26
Turkey ....do	....	7	6	5	11	5
Other countries ....do	7	4	2	6	6	[2] 2
World production ....long tons	428, 000	1, 260, 000	1, 115, 000	1, 155, 000	1, 123, 000	(3)

[1] Originated in Southern Rhodesia, Union of South Africa, and British West Africa.
[2] Greece (less than 1 percent) included under "Other countries."
[3] Data not available.

GOVERNMENT EXPLORATION

In accordance with section 7 of the strategic materials act (53 Stat. 811), the Geological Survey and the Bureau of Mines continued the search for and appraisal of ore deposits containing metals designated as strategic by the Secretaries of War, Navy, and Interior upon the advice of the Army and Navy Munitions Board. The act authorized the expenditure of $500,000 a year—$350,000 by the Bureau of Mines and $150,000 by the Geological Survey—for each of the 4 fiscal years ending June 30, 1940, 1941, 1942, and 1943. The two bureaus are cooperating closely to facilitate accomplishment of the objectives of the act.

In carrying out its part of the program, the Bureau of Mines [1] seeks to determine (1) the extent and quality of the ore, (2) the most suitable method of mining and beneficiating it, and (3) the cost at which it may be produced.

Exploration by the Bureau of Mines [2] of the chromite deposits in Stillwater and Sweet Grass Counties, Mont., carried on in 1939 and 1940 was continued during 1941. Extensive diamond drilling represents

[1] Finch, John W., Strategic Minerals Investigations—Procedure Followed by the Bureau of Mines. Bureau of Mines Inf. Circ. 7097, 1939, pp. 1-5.
[2] Jackson, C. F., Annual Report of the Mining Division, Fiscal Year 1941: Bureau of Mines Rept. of Investigations 3596, 1941, pp. 11-22, 24-25.

the present phase of the investigations, which had been preceded by trenching and large-scale sampling. The Bureau of Mines also conducted examinations in Siskiyou and Glenn Counties, Calif., by trenching and drilling. Special investigations included magnetic and gravimetric surveys of a selected area in the serpentine belt of northern Maryland and southern Pennsylvania, which formerly yielded large supplies of chromite. Drilling will be carried on at selected points.

The Geological Survey mapped in 1941 in considerable detail five chromite deposits in Siskiyou and Tehama Counties, Calif., Skagit County, Wash., and Baranof Island, Alaska. Mapping of the chromite zone of the Stillwater Complex in Stillwater and Sweet Grass Counties, Mont., was continued. In cooperation with the Bureau of Mines, deposits in Siskiyou, Glenn, and San Luis Obispo Counties, Calif., and on the Kenai Peninsula, Alaska, were examined further. Several smaller districts in the United States and Alaska were inspected briefly.

A report [3] was published by the Geological Survey in 1942 on field work performed in connection with the strategic minerals investigations.

The chemical laboratory of the Geological Survey made 52 complete and 143 partial analyses of cleaned chromite from the United States and Alaska, Cuba, Brazil, and other countries of the Western Hemisphere during the years 1939–41.

Investigations of the Metallurgical Division of the Bureau of Mines [4] during the fiscal year 1941 were concerned with the production of high-grade chromium (metal) and standard-grade ferrochromium.

A new method, known as a roasting and leaching process, was developed to convert chromite concentrates into a higher grade of material, which may be used to produce either high-purity chromium or standard ferrochromium for the manufacture of alloy steel. The process is capable not only of increasing the chromium content of the ore but also of raising the ratio of chromium to iron from about 1.7 : 1 to as much as 30 or 40 : 1. In this method, the chromite concentrates are mixed with coke and treated in an especially designed rotary kiln. The material thus treated is cooled, and part of the iron is removed by gravity concentration or by magnetic methods. Additional reduced iron may be removed by leaching with sulfuric acid or sulfur dioxide, leaving the residue enriched in chromium. The Bureau's research indicates that it probably will be most economical to produce a residue having a ratio of 5 parts chromium to 1 part iron. This will permit mixing 2 tons of residue with 1 ton of raw concentrates to produce a product having a chromium : iron ratio of 3 : 1.

A form of sponge, or powdered, chromium (metal) that under certain conditions attains a purity of 99.8 percent—higher than any chromium used in present commercial manufacturing—was also produced from both low- and high-grade domestic chromite.[5] Low-temperature reduction without sintering is the basis of the process. The fundamentals consist in the chlorination of chromite at elevated temperature, the sublimation and separation of volatile chlorides, and the

[3] Guild, Philip W., Chromite Deposits of Kenai Peninsula, Alaska: Geol Surv. Bull. 931–G, 1942, pp. 139–175.

[4] Dean, R. S., Progress Reports—Metallurgical Division. 50 Annual Report of the Metallurgical Division, Fiscal Year 1941: Bureau of Mines Rept of Investigations 3600, 1941, pp. 40–42.

[5] Maier, C. G., Sponge Chromium: Bureau of Mines Bull 436, 1942, 109 pp.

reduction of the chlorides to metal by hydrogen. The new reduction process may, under favorable circumstances, permit a large amount of low-grade domestic chromite to be utilized at costs comparable with the existing prices of low-carbon ferrochromium. Its future in this field will depend chiefly on the availability and cost of chlorine, the chemical used extensively in producing this new metallurgical material. Its high purity and powdered form are said to render it valuable in the manufacture of special steels, brass and bronze materials, and alloys that are subjected to high temperatures, such as electrical heating elements.

OFFICE OF PRODUCTION MANAGEMENT AND WAR PRODUCTION BOARD

Chromium was one of 16 metals (and classes of metals) subject to inventory control by virtue of General Metals Order 1, issued on May 1, 1941, by the Office of Production Management. In this and subsequent orders "chromium" refers to ores, concentrates, all chromium-bearing products, and scrap, unless otherwise specified.

Chromium was removed from the general order on July 7 and placed under full priority control in Order M–18. The main provisions of this order were the following:

1. All defense orders were assigned a preference rating of A–10 unless higher ratings were specifically given.
2. Monthly deliveries of chromium to be used in the manufacture of chemical products were limited to the average monthly consumption of the processor during the 12 months preceding June 30, 1941
3. Deliveries by processors of chromium refractory material were allowed only under defense orders or for necessary maintenance and repairs, except under other authorization.
4. Deliveries for nondefense purposes were permitted after fulfillment of all other terms of this order.
5. Restrictions against accumulation of excessive inventories were also established.

An amendment to Order M–18 became effective August 22. This statement was chiefly a clarification and redefinition of certain terms and provisions of the original order. The monthly use of chromium in ores and concentrates for production of chemicals was limited to a quantity of chromic oxide not greater than one-twelfth of the total annual consumption of oxide for this purpose by the processor during the period from July 1, 1940, to June 30, 1941. Acceptance of defense orders was made compulsory, subject to certain provisions.

Order M–18–a was issued on November 29, revoking the previous chromium orders. The new order included two main provisions:

1. Complete control of deliveries of chromium was placed in the hands of the Director of Priorities. Monthly requests for delivery of chromium were required to be made to producers.
2. The total chromic oxide content of ore to be used by any processor in the manufacture of chromium chemicals during any month was limited to one-twelfth of the aggregate oxide content used in chromium chemicals actually delivered by the processor during the period from July 1, 1940, to June 30, 1941.

On January 13, 1942, an amendment to Order M–18–a prohibited any person from melting more than 2 tons of ferrochrome in any month without specific authorization. The amendment was designed to conserve chromium steel for military needs. A further amendment was added on February 4, in which a complete allocation system for chromium (including scrap) was established. It was also stated therein that chromium could be melted only with specific permission.

Order M–18–b, effective March 26, 1942, limited the use of chromium in chemicals (including chromium for pigments, chromic acid, leather tanning, and wood preservation). The use of chromium in the manufacture of roofing materials, ceramics, soap, and glass was prohibited.

Chromium steel was subjected to regulation in Order M–21, relating to priority control over steel, first issued on August 9, 1941, and amended September 9. It was also included in Order M–21–a (September 16) and dealt with specifically in an amendment dated November 25. This last prohibited the manufacture and delivery of alloy iron or steel containing 4 percent or more chromium, except on preference ratings of A–10 or higher. Order M–21–d of December 27 provided that no person shall consume, fabricate, or deliver corrosion- or heat-resistant alloy iron or steel containing over 4 percent chromium after January 6, 1942, except on ratings of A–10 or higher. An amendment to this order, issued March 27, further restricted the use of steel with 4 percent or more chromium to orders with priority ratings of A–1–k or higher.

Chromium was one of the 13 materials listed in General Imports Order M–63, which provided that, as of December 28, 1941—

Unless otherwise authorized by O. P. M., all future contracts for imports of these materials will be handled by the Metals Reserve Co., R. F. C. subsidiary, or other governmental agency. No private person or concern can make arrangements for imports, except that in certain cases, such as imports for processing and immediate reexport, the Director of Priorities may grant specific exceptions to the Order.

METALS RESERVE COMPANY

On November 1, 1941, it was announced that the Metals Reserve Co. would consider contracts for the purchase of domestic chrome ore with a minimum Cr_2O_3 content of 40 percent. A memorandum detailing terms of contracts, quantity of ore, grade specifications, prices, shipments, and payments was released November 14. The purchasing schedule was revised December 19, 1941, and February 20 and May 25, 1942. An abstract of the schedule of May 25 follows:

1. *Quantity:* 1,000 to 10,000 long tons per contract. Contracts in excess of 10,000 tons may be obtained as a result of individual negotiations, provided reliable and complete engineering data submitted by the applicant warrant a contract for a larger quantity.
2. *Terms of contract:* Deliveries must be completed within 18 months of date of contract. If delivery of 20 percent of the tonnage contracted for has not been made within 6 months of date of contract, Buyer (Metals Reserve Co.) may cancel contract forthwith.
3. *Quality:* Purchases of domestic chrome ores will be of three grades, with the following specifications:

	High-Grade	Low-Grade	
		A	B
Cr_2O_3 .... percent minimum	45.00	40.00	40.00
SiO_2 .... percent maximum	11.00	13.00	None
P .... do	.20	.50	None
S .... do	.50	1.00	None
Cr : Fe ratio .... minimum	2.5:1	2.0:1	None

Under Low-Grade A and B, chrome ore will be accepted to 35 percent minimum under penalties described below.

4. *Size of ore:* None in excess of 12 inches.

Buyer may reject any shipment which does not conform to the applicable requirements and specifications as set forth above.

5. *Price:* Effective May 25, 1942, contracts will be considered on the following schedule for domestic ores within the continental United States (excluding Alaska); all prices per long ton (2,240 pounds) of dry weight, f. o. b. cars at stock pile designated by Buyer.

High-Grade—Base price: $40.50 per long dry ton for ore containing 45 percent Cr_2O_3, and with a ratio of chrome (Cr) to iron (Fe) of 2.5 : 1; with an increase of 90 cents per ton for each unit Cr_2O_3 in excess of 45 percent Cr_2O_3; with an increase of $1.50 per ton for each tenth increase in chrome : iron ratio to a maximum of 3.0 : 1.

Low-Grade A—Base price: $28.00 per long dry ton for ore containing 40 percent Cr_2O_3, with a ratio of chrome (Cr) to iron (Fe) of 2.0 : 1; with an increase of 90 cents per ton for each unit Cr_2O_3 in excess of 40 percent Cr_2O_3; with an increase of $1.50 per ton for each tenth increase in chrome : iron ratio to a maximum of 3.0 : 1. Chrome ore containing a minimum of 35 percent Cr_2O_3 but otherwise meeting the specifications set forth for this grade will be accepted with a penalty of $1.40 per long dry ton for each unit (22.4 pounds of Cr_2O_3) under 40 percent.

Low-Grade B—Base price: $24.00 per long dry ton for ore containing 40 percent Cr_2O_3, with an increase of 60 cents per ton for each unit Cr_2O_3 in excess of 40 percent Cr_2O_3. Chrome ore containing a minimum of 35 percent Cr_2O_3 but otherwise meeting the specifications set forth for this grade will be accepted with a penalty of $1.20 per long dry ton for each unit (22.4 pounds of Cr_2O_3) under 40 percent.

Fractions prorated in all cases.

In addition to the above prices, an allowance will be made for each long ton shipped equal to the freight tariff per long ton from Seller's nearest convenient rail station to Buyer's stock pile.

The cost of sampling and analysis by the Buyer, weighing, and unloading onto stock pile will be for the account of Buyer.

Each lot of ore will be graded in accordance with the specifications heretofore set forth (all elements to be within the range specified for the applicable grade), and the price to be paid for such ore will be governed accordingly.

6. *Shipment and Delivery:* Seller will give such advice regarding shipment and arrival as Buyer may require, at least 10 days prior to shipment of the ore from point of loading onto railroad cars; otherwise, any demurrage at the stock pile will be for Seller's account.

Shipment will be made in flat-bottom gondolas, if available, in lots of not less than 1 carload, to the stock pile designated by Buyer. Seller will prepay the freight to such stock pile, where the ore will be weighed in cars, light and loaded, on track scales, and sampled for moisture. The lot will be sampled as unloaded and upon receipt of analysis, Buyer will advise Seller as to whether the ore is acceptable and under what classification.

If the lot is ascertained to be unacceptable under the above specifications, Seller will not be entitled to any allowance for prepaid freight and will be held responsible for the removal of this shipment of ore from the stock pile location. Upon failure so to remove the ore within 15 days of due notice, Buyer may, at its absolute discretion, remove such ore and the cost of such removal shall be for Seller's account; or Buyer may, at its option, otherwise dispose of such ore without any liability therefor. In the event that Seller fails to repay Buyer, within 15 days after notice, for the cost of removal, Buyer may cancel the contract forthwith.

7. *Payment:* As soon as moisture and analysis determinations are received, Buyer will promptly pay Seller in accordance with the weight certificate and the above schedule.

8. *Weights:* The weight paid for will be net railroad track scale weights (weight of loaded car less weight of empty car), less moisture as determined by standard practice.

9. *Sampling and Analysis:* Each lot will be sampled at the time of unloading onto stock pile by a sampler designated by Buyer, three samples being taken, one each for Seller, Buyer, and Umpire, and analysis made for chrome and other guaranteed elements. Usual provisions will be made for splitting limits and settlement by average of Seller's and Buyer's analyses, or by trade practice if samples are sent to Umpire. Moisture samples will be taken in accordance with standard practice. Seller may have representative at sampling at his own expense.

To stimulate production from small chromite deposits in Oregon and northern California and to provide a ready market for the ore, the Metals Reserve Co. announced on March 5, 1942, that truckload lots of ore mined in these localities would be purchased. Purchase depots, at which agents are located, were provided at Coquille, Grants Pass, and Seneca, Oreg., and at Yreka, Calif., and others are being established. Ore or concentrates delivered at the depots will not be accepted as delivery on contracts made under earlier schedules. This buying plan became effective April 1, 1942, for 1 year. Grade specifications and prices are the same as in the May 25 schedule summarized above. Payment will be made as soon as lots of 10 tons or more have been delivered and analyzed.

DOMESTIC PRODUCTION

The domestic output of chromite, in terms of shipments from mines, totaled 12,731 long tons in 1941 compared with 2,662 tons in 1940. Shipments in 1941 were the largest in any year since 1918. A table showing annual shipments of chromite from mines in the United States from 1910 to 1941 is given in the section of this report on "Consumption."

California and Oregon were the only States from which chromite was shipped in 1941; the former furnished the bulk of the total. Most of the chromite shipped from California came from properties in Del Norte, Eldorado, Fresno, Humboldt, and Placer Counties. The largest individual source was the Pilliken mine in Eldorado County, operated by the Rustless Mining Corporation; the concentrates produced from Pilliken ore averaged 43 percent Cr_2O_3 and 26 percent FeO in 1941. The second most important property, in quantity shipped, was the High Plateau mine in Del Norte County, operated by Eugene R. Brown. In Oregon, chromite was shipped from mines in Curry, Jackson, and Josephine Counties.

Extensive development work was reported from various localities. In California especially a large number of properties were stated to be under development, and in some places ore was mined but not shipped. Some of the larger projects undertaken during 1941 are summarized as follows:

In Montana, the Anaconda Copper Mining Co. developed a mine in the deposits of Stillwater County and constructed a mill. Shipments of concentrates were to begin early in 1942. The project was carried out by the Anaconda company at the request of the Office of Production Management and the Metals Reserve Co., with funds provided by the Reconstruction Finance Corporation. Under a similar arrangement with the Government, the company will develop and equip further mines and mills in the Stillwater area. The United States Vanadium Corporation began a chromite mining and milling operation in Carbon County, Mont. A mill with an initial capacity of 200 tons a day was under construction at Red Lodge, and ore for milling was being hauled from the mine to the mill site in 1941.

In California, the Rustless Mining Corporation began to build a 200-ton mill in Glenn County to concentrate ore from the Gray Eagle mine.

In Oregon, the Krome Corporation, which plans to concentrate chromite from black beach sands, undertook to construct a plant near Port Orford in Curry County.

Chromite (ores and concentrates) shipped from mines in the United States, 1937-41

	1937	1938	1939	1940	1941
Ores and concentrates containing—					
45 percent or more chromic oxide.....long tons..	[1] 2,006	[1] 812	3,056	238	4,286
35 to 45 percent chromic oxide.............do.....	[1] [2] 315	([1])	558	[2] 2,424	[2] 8,445
Total:					
Long tons....................................	[2] 2,321	812	3,614	[2] 2,662	[2] 12,731
Value..	$14,888	$10,730	$46,892	$28,784	$274,062

[1] Small quantity of ore containing 35 to 45 percent chromic oxide included with ore containing 45 percent or more.
[2] Includes small quantity of ore containing less than 35 percent chromic oxide.

IMPORTS [6]

Imports of chromite in 1941 reached a new peak, exceeding the previous high of 1940 by 51 percent. Despite war conditions, which hampered shipping throughout the world, the principal foreign sources of chromite continued to furnish large supplies. The only notable decrease was in shipments from British India, Greece, and Turkey. The imported chromite averaged 45 percent Cr_2O_3 in 1941, as compared with 46 percent in 1940. The imports from New Caledonia had the highest chromic oxide content (52 percent), and those from Cuba had the lowest (35 percent).

The following table shows imports of chromite into the United States, 1937-41, by countries; and a table showing annual imports from 1910 to 1941 is given in the section of this report on "Consumption."

Crude chromite imported for consumption in the United States, 1937-41, by countries

Country	Gross weight (long tons)				1941		
					Long tons		Value
	1937	1938	1939	1940	Gross weight	Chromic oxide content	
North America:							
Canada.................	1	2	1	187	351	175	$6,829
Cuba....................	93,098	39,529	66,002	51,955	160,644	55,823	1,356 080
Other..................	5	59	1,902				
	93,104	39,590	67,905	52,142	160,995	55,998	1,362,909
South America: Brazil.......				2,790	5,361	2,494	78,742
Europe:							
Greece.................	24,583	10,000	11,000	14,041	1,963	890	41,223
Other..................		3,000	1,000	1,000			
	24,583	13,000	12,000	15,041	1,963	890	41,223
Asia							
India, British..........	23,939	4,051	16,468	32,644	9,741	4,856	182,604
Philippine Islands......	43,648	78,233	71,914	156,566	257,510	110,309	2,273,628
Turkey..................	39,391	20,392	16,632	70,081	55,219	25,907	1,099,723
	106,978	102,676	105,014	259,291	322,470	141,072	3,555,955
Africa [1]...................	277,420	168,299	118,233	285,559	424,444	203,451	5,926,599
Oceania....................	51,831	28,520	14,359	42,866	80,543	41,993	1,653,153
	553,916	352,085	317,511	657,689	995,776	445,898	12,618,581

[1] Originated in Southern Rhodesia and Union of South Africa; recorded by the Department of Commerce as imported from Union of South Africa, "Other British South Africa," "Other British West Africa," and Mozambique.

[6] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

No imports of chromium compounds were recorded in 1940 or 1941; a table showing imports of these compounds from 1937 to 1939 is given in Minerals Yearbook, Review of 1940, page 591.

The following table shows imports of ferrochromium and chromium into the United States from 1937 to 1941.

Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1937–41, in long tons

Class	1937	1938	1939	1940	1941
Ferrochrome or ferrochromium—					
Containing 3 percent or more carbon (chromium content)	96	(1)	3	(2)	79
Containing less than 3 percent carbon (chromium content)	164	121	127		
Chrome or chromium metal	78	39	56	(3)	

[1] 60 pounds. [2] 1,020 pounds. [3] 1,000 pounds.

PRICES

Nominal prices of chromite for import are quoted in domestic trade journals in dollars per long ton, c. i. f. North Atlantic ports. At the beginning of 1941, Engineering and Mining Journal Metal and Mineral Markets quoted Indian and African 48 percent metallurgical ore at \$32 to \$34. The price rose during the year and in September reached \$47 to \$49; during the last quarter, it held at \$45 to \$47. Refractory ore (43 to 45 percent) opened the year at \$22 to \$24 and increased to \$30 to \$32, a price that was maintained for the last 4 months of 1941.

Prices for domestic chromite were established by the Metals Reserve Co. in its schedule of November 14 and revised on December 19. The following were the base prices per long dry ton, f. o. b. stock pile designated by the Metals Reserve Co.:

November 14:	
48 percent Cr_2O_3, Cr · Fe=3·1	\$43.20
40 percent Cr_2O_3	22.00
December 19:	
45 percent Cr_2O_3, Cr : Fe=2.5:1	40.50
40 percent Cr_2O_3, Cr : Fe=2:1	28.00
40 percent Cr_2O_3, no Cr : Fe ratio specified	24.00

CONSUMPTION

Consumption of all grades of chromite in the United States during 1941 amounted to 714,645 long tons. Actual data on consumption have not been published before, but at the close of 1940 the annual rate was reported to be about 600,000 tons. For purposes of comparison, the apparent available supply may be used as an indicator of the requirements in the years preceding 1941. Since institution of the Government purchasing program, part of the new supply—comprising shipments from domestic mines and imports for consumption—has entered Government stock piles, from which an undisclosed quantity has been released to consumers. The following table, covering the period from 1910 to 1941, shows the general upward trend in apparent supply of chromite and reflects the increasing demand. During World War I, domestic production constituted a significant

source of supply, but since 1920 virtually all the chromite consumed in the United States has been imported.

Domestic production, imports, and apparent available supply of chromite in the United States, 1910–41

Year	Domestic production (shipments from mines)					Imports (long tons)	Apparent available supply [1] (long tons)
	Long tons				Total value		
	California	Oregon	Other States [2]	Total			
1910	205			205	$2,729	38,579	38,784
1911	120			120	1,629	37,540	37,660
1912	201			201	2,753	53,929	54,130
1913	255			255	2,854	65,180	65,435
1914	506		85	591	8,715	74,686	75,277
1915	3,281			3,281	36,744	76,455	79,736
1916	43,758	3,099	178	47,035	726,243	115,945	162,980
1917	36,774	6,701	250	43,725	1,049,400	72,063	115,788
1918	63,147	18,454	829	82,430	3,955,567	100,142	182,572
1919	3,272	538	1,269	5,079	129,302	61,404	66,483
1920	1,416	955	131	2,502	44,857	150,275	152,777
1921	123	159		282	2,900	81,836	82,118
1922	163	79	113	355	7,288	90,081	90,436
1923	69	78	80	227	3,819	129,693	129,920
1924	188	100		288	1,140	118,343	118,631
1925	83		25	108	2,105	149,739	149,847
1926	91		50	141	2,079	215,464	215,605
1927	[3] 201			201	[3] 5,063	222,360	222,561
1928	652		8	660	14,807	216,592	217,252
1929	269			269	3,976	317,630	317,899
1930	80			80	1,905	326,617	326,697
1931	268			268	3,509	212,528	212,796
1932	155			155	2,160	89,143	89,298
1933	843			843	11,585	116,511	117,354
1934	369			369	4,653	192,297	192,666
1935	515			515	6,163	259,063	259,578
1936	269			269	2,978	324,258	324,527
1937	2,033	288		2,321	14,888	553,916	556,237
1938	812			812	10,730	352,085	352,897
1939	3,514	100		3,614	46,892	317,511	321,125
1940	2,422	240		2,662	28,784	657,689	660,351
1941	11,981	750		12,731	274,512	995,776	1,008,507

[1] Domestic production plus imports, no exports recorded, 1910–41.
[2] Maryland, North Carolina, Washington, and Wyoming.
[3] According to Division of Mines and Mining, Department of Natural Resources, California

Over 80 percent of the chromite supply is consumed in the steel industry, either as a source of the alloying element chromium or in refractories. Stainless steel has been one of the principal chromium-bearing products, of which important quantities were used by the automotive industry. In 1940 nearly 60 percent of the total metallurgical ore consumed was in stainless steels.[7]

USES

The industrial uses of chromite are classified in three groups: Metallurgical, refractory, and chemical. For use in making alloy steels chromite is generally first converted into ferrochromium, an alloy containing 60 to 70 percent chromium, before being added to the steel bath. Ferrochromium is produced in high- and low-carbon grades. On December 17, 1941, the Office of Production Management announced that all domestic producers of ferrochromium had agreed voluntarily to change specifications for the high-carbon in order to permit the use of lower-grade ores and to conserve the higher grades.

[7] Advisory Committee to W. P. B. on Metals and Minerals, Ferrous Minerals and Ferro-Alloys Group, Chrome Ore, Its Conservation and Substitution: Metal Prog., vol. 41, No. 4, April 1942, pp. 503–506.

The new specifications are approximately the same as those in use during World War I. The specifications—formerly 68 to 69 percent Cr, 4 to 6 percent C, and 1 to 2 percent Si—are now 60 to 63 percent Cr, 6 to 8 percent C, and 4 to 6 percent Si.

One solution of the problem of using low-grade ores for metallurgical purposes is offered by Udy,[8] who has developed "Chrom-X," a product being manufactured in high- and low-carbon grades. The use of "Chrom-X" in the production of chromium steels was described by McDonald.[9]

Chromium plating constitutes an important industrial application of this element, although small quantities are consumed. Chromic acid is the raw material for this purpose. A review by Hall [10] of latest research in this field shows that "hard" chromium plating was the principal object of studies during 1941.

The "Inkrom" process [11] of chromium impregnation of iron and steel surfaces was discussed by Rudorff,[12] who reported that it is in full commercial use in Germany. The process involves the introduction of gaseous chromium chloride to the surface to be treated. The surface zones of chromised materials assume properties similar to those of rustless steel. Important fields of application of the process are in the manufacture of turbine blades, tubing, bolts, and screws.

For refractory purposes certain grades of chromite in the form of lump or ground ore may be used directly. Chromium cements, plastics, and bricks are also produced for similar uses. At present about 6 pounds of chromite are consumed as a refractory in the production of each ton of steel.[13]

Chromium chemicals are used in dyeing, tanning, and pigments and in pickling solutions in nonferrous-metals industries.

WORLD PRODUCTION AND TRADE

Statistics on world production of chromite in 1941 are incomplete, but available data indicate that the output was greater than in 1940. The United States, as the leading consumer of chromite, depends largely on imports for its supply. The record attained in 1941 in imports, which amounted to 1,011,758 metric tons, gives strength to the belief that world production increased, although some of the imports may have come from stocks in foreign countries. The following table shows the Philippine Islands and Cuba as the chief producers of chromite in 1941; however, estimates of the output from Southern Rhodesia and U. S. S. R. suggest that these countries should be considered among the leaders in chromite production.

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[8] Udy, Marvin J., "Chrom-X" and Our Chromium Problem: Metals and Alloys, vol. 14, No 1, July 1941, pp. 52-55.

[9] McDonald, John H., Use of "Chrom-X" in Steel Making: Metals and Alloys, vol 15, No 2, February 1942, pp. 249-253.

[10] Hall, Nathaniel, Technical Developments of 1941: Metal Finishing, vol. 40, No. 1, January 1942, pp. 2-11.

[11] The Metal Bulletin, Inside Europe Today—Germany: No. 2645, November 21, 1941, p 8.

[12] Rudorff, D. W., A New Chromising Process Metal Ind., vol 59, No. 13, September 26, 1941, pp. 194-195.

[13] Advisory Committee to W. P. B. on Metals and Minerals, Ferrous Minerals and Ferro-Alloys Group: Work cited in footnote 7.

World production of crude chromite, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Australia: New South Wales	466	967	(2)	(2)	(2)
Brazil (exports)	2,980	934	3,554	4,572	5,944
Bulgaria	2,350	1,745	4,251	6,000	(2)
Canada (shipments)	3,876	------	------	(2)	(2)
Cuba [3]	94,592	40,163	67,061	52,789	163,222
Cyprus (shipments)	1,641	5,667	(2)	4,775	(2)
Greece	52,620	42,464	57,091	[4] 33,118	(2)
Guatemala [3]	------	------	1,933	------	------
India, British	63,307	44,858	49,925	(5)	(2)
Japan	[6] 40,000	(5)	(5)	(5)	(2)
New Caledonia	48,022	52,216	52,000	55,790	(2)
Norway	176	508	371	(2)	(2)
Philippine Islands (exports)	69,856	66,911	126,749	194,393	[6] 300,000
Sierra Leone	741	505	10,755	17,777	(2)
Southern Rhodesia	275,617	186,019	139,083	(5)	(2)
Syria and Lebanon	------	500	(2)	(2)	(2)
Turkey (Asia Minor)	192,508	213,630	191,644	[4] 110,037	[6] 100,000
Union of South Africa	168,620	176,561	166,927	106,393	[7] 120,335
U. S. S. R.	[6] 200,000	(5)	(5)	(5)	(2)
United Kingdom	305	473	(2)	(2)	(2)
United States (shipments)	2,358	825	3,672	2,705	12,935
Yugoslavia	59,932	58,470	59,527	[8] 58,512	(2)
	1,280,000	1,133,000	1,174,000	1,141,000	(2)

[1] In addition to countries listed, chromite mining was reported in Albania in 1938 and in Mexico (12 tons) in 1941, no further production figures are available
[2] Data not available
[3] Imports into United States
[4] Exports
[5] Estimate included in total
[6] Estimated
[7] January to November, inclusive.
[8] January to October, inclusive

Most of the world output of chromite enters international trade, as the principal producing countries are not important consumers. Notes concerning countries that produce and consume chromite and developments of potential sources follow:

Brazil.—The Cascabulhos mine, 12 miles west of Campo Formosa in the State of Baía, was the only active chromite producer in 1941. The concentrates average about 48 percent Cr_2O_3 and have a Cr:Fe ratio of 2.9:1. Shipments of chromite were also made from an old stock pile at Santa Luzia, Baía.

Chromite was included in the list of strategic or critical minerals specified in an agreement between the United States and Brazil whereby the United States contracted for all of Brazil's production during the next 2 years. The United States Government will purchase any ore not taken by private American buyers.

Canada.—The Sterrett chromite property at St. Cyr, Quebec, which produced considerable quantities of chromite during World War I, was reopened and was said to be producing at the rate of 100 tons a week at the end of 1941. Ore reserves were estimated at about 20,000 tons, averaging 28 percent chromite. Chromite, Ltd., now operating the property, began to construct a 50-ton concentrator late in September. Exploratory work was carried on in Quebec and British Columbia The Government was reported to have begun an investigation of chromite possibilities in the Black Lake area, Eastern Townships, Quebec.

Cuba.—At Moa, Province of Oriente, exploitation of chromite deposits was begun; reserves are estimated at 150,000 tons. Cuba's entire output of chromite is shipped to the United States. Imports

into the United States were 163,222 metric tons in 1941 compared with 52,789 tons in 1940.

Germany.—An important consumer of chromite, Germany depends on foreign sources of supply. At present, sources within Europe and Asia Minor appear to be the only ones to which Germany can look. About 100,000 tons of chromite have been produced annually in the Balkans, principally from deposits in Yugoslavia and Greece. Bulgaria has a small output, and Rumania has deposits that were exploited by the German Army during the first World War.[14] It may be assumed that chromite mined in Norway, a minor producer, will also be available to Germany. As a result of a trade agreement, Germany is to obtain 90,000 to 100,000 tons of chromite from Turkey in both 1943 and 1944.

India.—Virtually all of India's chromite output has been exported. Nearly one-half of the production comes from Mysore State, and about one-third is furnished by the Hindubah mines near Quetta. Curtailment of foreign supplies of bichromates led to the opening of the Pioneer Chromate Works at Andheri, equipped to produce 400 long tons annually. Imports of most chromium compounds are subject to license control, and certain restrictions have been placed on the use of such compounds.

New Caledonia.—Early in 1941 the Free French Government of New Caledonia prohibited the exportation of chromite to Japan. The Tiébaghi mine, one of the richest chromite mines in the world, was reported to be making shipments to the United States at the rate of about 7,500 tons monthly. The Fantoche mine had shipped its entire stock to the United States by the end of July, but exports were to be resumed early in 1942. A brief review of chromite deposits in New Caledonia was given by Priday.[15]

Newfoundland.—Development work continued on the recently discovered chromite deposit in the Lewis Hills on the north side of Fox Island River, near Port-au-Port Bay, western Newfoundland. Irregular lenses of ore occur in a zone about 1,200 feet long. Based upon diamond drilling to shallow depths, the ore reserves were estimated at almost 12,000 tons averaging 37 percent Cr_2O_3.

Philippine Islands.—According to Boericke,[16] approximately half of the Philippine chromite exports are of refractory-grade ore, all from the Masinloc deposit in Zambales Province. The remainder is high-grade ore, mostly from the Acoje Mining Co. property at Santa Cruz, Zambales. A new operation in Oriental Misamis, Mindanao, yielded about 14,000 tons of ore averaging over 50 percent Cr_2O_3. Frasché[17] estimates the chromite reserves in the Philippine Islands to be 10,890,500 metric tons, of which 10,120,000 are of refractory grade, 450,500 of chemical grade, and 320,000 of metallurgical or submetallurgical ore.

Southern Rhodesia.—Rhodesian Chrome Mines, Ltd., of Bulawayo, and the affiliated African Chrome Mines, Ltd., of Salisbury, are reported to be producing 90 percent of the chromite output of the country from the Selukwe district. The Southern Rhodesian produc-

[14] Allen, Robert, and Howling, G. E., Chrome Ore and Chromium. Imperial Inst., 1940, p. 70.
[15] Priday, H. E. L., New Caledonia's Mineral Wealth. Chem. Eng. and Min. Rev., vol. 33, No. 396, September 10, 1941, pp. 369–373.
[16] Boericke, W. F., Chromite in the Philippines. Eng. and Min. Jour., vol. 142, No. 11, November 1941, pp. 38–40.
[17] Frasché, D. F., Chromite Deposits of the Philippine Islands (abs.). Econ. Geol., vol. 36, 1941, pp. 845–846.

tion, now thought to be proceeding at the rate of about 325,000 tons a year, represents the full capacity of the mines.

Turkey.—Late in 1939 Turkey ceased exporting to Germany, principal purchaser of Turkish chromite before the war. Since then shipments have been made to the United States, England, and France. Following the collapse of France in 1940, Great Britain obtained that country's share of the output. During 1941 Germany concluded trade negotiations with the Turkish Government, and it was indicated that 90,000 to 100,000 tons of ore would be furnished in both 1943 and 1944, contingent upon the delivery by Germany of war materials to the extent of £T18,000,000 before 1943. Subsequent deliveries of ore were to be made only upon receipt of German war materials of equal value.

United Kingdom.—In October 1941 it was announced that the Chrome Ore Control would henceforth purchase all chromite (ore and concentrates) required in the United Kingdom. Consumers will make their applications to the Control for quantity and quality of ore desired. The Control will undertake to deliver the chromite to consumers and establish price schedules for all grades delivered at consumers' plants. No licenses are necessary for such purchases. The decision of the Government to purchase chromite was prompted by the inequitable distribution to consumers during periods of freight shortage. A strain on internal transportation facilities had also been caused by transfers of ore between plants in Great Britain. Early in 1942 the Ministry of Supply decided that chromium plating for a wide variety of purposes would be discontinued in consideration of the great demand for chromic acid.

NICKEL

By H. W. Davis

SUMMARY OUTLINE

Although world production of nickel reached an all-time high in 1941, the supply available fell short of the unprecedented demands for nickel for war purposes of the United Nations. As a consequence, peacetime industrial consumers had to curtail sharply their use of nickel steels and other nickel-bearing products. On March 7, 1941, primary nickel deliveries and allocations in the United States were placed under priority control by the Office of Production Management. The United States consumed over two-thirds of the total world nickel available in 1941, of which steel mills used about 70 percent and nonferrous rolling mills most of the remainder.

Although figures are not obtainable, Canada undoubtedly furnished a larger proportion of the world nickel supply than in 1940. The International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd., have extensive expansion programs under way that will further increase the nickel supply.

Salient statistics for nickel, 1937–41

	1937	1938	1939	1940	1941
United States:					
Production:					
Primary .... short tons	219	416	394	554	660
Secondary .... do	2,400	2,300	2,920	5,150	(1)
Imports (gross weight)[2] .... do	54,438	29,546	64,796	92,468	124,130
Exports (gross weight)[3] .... do	4,473	6,581	10,167	11,994	7,111
Price per pound[4] .... cents	35	35	35	35	35
Canada:					
Production .... short tons	[5] 112,453	105,286	113,053	(1)	(1)
Imports .... do	491	491	697	(1)	(1)
Exports .... do	111,385	98,852	117,391	(1)	(1)
World production (approximate) .... do	132,000	127,000	(1)	(1)	(1)

[1] Figures not yet available.
[2] Excludes "All other manufactures of nickel"; weight not recorded.
[3] Excludes "Manufactures"; weight not recorded.
[4] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.
[5] Excludes small quantity produced in British Columbia.

In 1941, as usual, the domestic production of primary nickel was insignificant. In addition to the nickel produced as a byproduct in the electrolytic refining of copper and as secondary nickel, comparatively small quantities were produced from ore mined in Colorado and as a byproduct of talc production in Vermont.

Continuing the search for ore deposits of strategic metals, as authorized under section 7 of the Strategic Materials Act, the Bureau of Mines completed diamond drilling of a large body of low-grade copper-nickel ores in Stillwater County, Mont. This drilling aggregated 5,981 feet, which, taken in conjunction with earlier drilling and underground exploration by a commercial company, revealed a few million tons of material averaging 0.4 percent nickel and 0.37 percent copper. Exploration of low-grade deposits on Yakobi Island in Alaska included the completion of two diamond-drill holes which indicated material of about the same average grade as that exposed in surface outcrops. This work was recessed on account of severe weather conditions, to be resumed in the spring of 1942.

As part of its program of investigation, the Geological Survey published reports describing the nickel deposits on Yakobi Island, Alaska; near Riddle, Douglas County, Oreg.; and near Mount Vernon, Skagit County, Wash.

According to Reed and Dorr: [1]

Calculations based on the investigations made by the Geological Survey in 1940 indicate that about 6,000,000 tons of rock, containing about 0.36 percent of nickel and 0.27 percent of copper, is present and available for mining in the eight bodies that have been partly prospected. Further prospecting will probably greatly increase the estimate of the tonnage available in the bodies, but it probably will not greatly change the estimate of the grade. Rough calculations indicate that the material can be mined and the nickel and copper extracted from it at a cost roughly equal to the value of the metals that would be produced.

Concerning the nickel deposit near Riddle, Douglas County, Oreg., Pecora and Hobbs [2] write:

About 162 acres of ground are underlain by a blanket containing over 6,000,000 tons of material, 1 to 2 percent of which is probably nickel. Eighty thousand tons have been proved to contain 2 to 3 percent of nickel, and 75,000 tons have been proved to contain 1 to 2 percent of nickel. A new method of treating low-grade silicate material would have to be devised before this large deposit could be utilized.

The following paragraph is quoted from a report by Hobbs and Pecora: [3]

The silica-carbonate rock on Devils Mountain cannot properly be considered a large potential nickel reserve. At best, if selective large scale low-cost mining methods and favorable means of concentration are employed, it might be considered a marginal to submarginal gold deposit, whose value would be slightly enhanced by the small amount of nickel recoverable from the sulfide minerals of the concentrates. The sulfide-bearing breccia, because of its uneven tenor and small tonnage, cannot be depended upon to sustain any long mining operation. Some of it, however, might be mined at a profit under present economic conditions. This sulfide ore could best be mined selectively, on a small scale, and concentrated by flotation, to which the ore is well adapted.

PRODUCTION

Domestic production of nickel is small and comprises secondary metals recovered from scrap-nickel anodes, nickel-silver, and copper-

[1] Reed, J. C., and Dorr, J. V. N., Nickel Deposits of Bohemia Basin and Vicinity, Yakobi Island, Alaska: Geol. Survey Press Notice 144,067, 1941, 2 pp.

[2] Pecora, W. T., and Hobbs, S. W., Nickel Deposit near Riddle, Douglas County, Oreg.: Geol. Survey Bull. 931-I, 1942, pp. 205-226.

[3] Hobbs, S. W., and Pecora, W. T., Nickel-Gold Deposit near Mount Vernon, Skagit County, Wash.: Geol. Survey Bull. 931-D, 1941, pp. 57-78.

nickel alloys (including Monel metal) and primary metal recovered in copper refining and produced from ore and as a byproduct of talc production, as listed in the following table. Domestic primary nickel is recovered as a byproduct in copper refining at Baltimore, Md., Laurel Hill, N. Y., Perth Amboy, N. J., and Tacoma, Wash. A matte containing 22.58 percent nickel, 4.28 percent copper, and 1.46 percent cobalt was produced in 1941 from ore mined near Gold Hill, Colo. Concentrates containing 13.39 percent nickel and 1.27 percent cobalt were recovered as a byproduct of talc production in Vermont in 1941.

Nickel produced in the United States, 1937–41

Year	Primary (short tons) [1]		Secondary [2]	
	Byproduct in copper refining [3]	Other [4]	Short tons	Value
1937	219		2,400	$1,680,000
1938	416		2,300	1,610,000
1939	394		2,920	2,044,000
1940	554		5,150	3,605,000
1941	619	41	(5)	(5)

[1] Bureau of Mines not at liberty to publish value.
[2] Nickel recovered as metal and in nonferrous alloys and salts.
[3] Nickel content of nickel salts and metallic nickel.
[4] Nickel content of matte produced from ore and of concentrates produced as a byproduct of talc.
[5] Figures not yet available; they will be found in the chapter on Secondary Metals—Nonferrous.

FOREIGN TRADE[4]

The nickel imported into the United States in 1941 comprised chiefly metallic nickel and nickel alloys, matte, and oxide. All the oxide, 63,220,793 pounds of the matte, and 149,447,516 pounds of the metallic nickel and alloys were obtained from Canada; virtually all the remainder of the matte (16,671,607 pounds) came from New Caledonia; and the rest of the metallic nickel and alloys (539,406 pounds) came from Europe, chiefly the United Kingdom (538,931 pounds). The matte from Canada, which contains approximately 55 percent nickel and 25 percent copper, is refined to Monel metal and other products at the plant of the International Nickel Co., Inc., Huntington, W. Va. The matte from New Caledonia, which contains about 77 percent nickel, will also be refined at Huntington, where a new plant has been provided primarily for refining raw material from New Caledonia and elsewhere. The nickel content of the unmanufactured nickel products imported into the United States is estimated at 212,363,000 pounds in 1941, as compared with 167,519,000 pounds in 1940. Imports of nickel in 1941 were the largest on record.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of all classes except nickel silver decreased substantially. The United Kingdom (6,021,581 pounds) was the chief market for nickel, Monel metal, and other alloys in 1941.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Nickel imported for consumption in the United States, 1939–41, by classes

Class	1939		1940		1941	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	28, 433, 530	$3, 749, 992	34, 889, 970	$4, 705, 454	79, 892, 400	$11, 267, 845
Nickel pigs, ingots, shot, etc	99, 309, 184	24, 914, 172	140, 625, 658	35, 152, 218	149, 466, 723	37, 429, 028
Nickel bars, rods, tubes, etc	216, 874	98, 848	434, 139	193, 284	520, 199	227, 319
Nickel oxide	1, 631, 558	311, 128	8, 986, 834	1, 692, 961	18, 377, 937	3, 039, 026
Manufactured:						
Nickel silver or German silver in sheets, strips, rods, and wire			153	84	2, 800	2, 545
All other manufactures of nickel	(1)	4, 060	(1)	1, 787	(1)	1, 785
		29, 078, 200		41, 745, 788		51, 967, 548

[1] Quantity not recorded.

Nickel exported from the United States, 1938–41, by classes

Class	1938		1939		1940		1941	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Nickel, Monel metal, and other alloys	11, 877, 498	$2, 896, 806	18, 978, 606	$5, 076, 383	21, 845, 989	$7, 416, 252	12, 190, 549	$4, 608, 139
Manufactures	(1)	606, 892	(1)	495, 639	(1)	1, 393, 636	(1)	863, 011
Nickel-chrome electric resistance wire	490, 640	552, 470	554, 027	609, 611	640, 816	777, 539	336, 123	381, 927
Nickel silver or German silver in bars, rods, or sheets	794, 811	91, 290	800, 456	136, 397	1, 502, 071	269, 907	1, 694, 800	359, 732
		4, 147, 458		6, 318, 030		9, 857, 334		6, 212, 809

[1] Quantity not recorded.

WORLD PRODUCTION

Because of Government restrictions on the publication of statistics for many countries, few figures for 1940 and 1941 are available; however, production during 1941 was the largest on record.

World production of nickel (content of ore), 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Australia		20		(2)	(2)
Brazil	104	375	25	(2)	(2)
Burma	1, 233	959	921	(2)	(2)
Canada	[3] 102, 015	95, 514	102, 559	(2)	(2)
Egypt	14	33	(2)	(2)	(2)
Germany	890	550	(2)	(2)	(2)
Greece	957	1, 207	1, 336	(2)	(2)
Italy	68	[4] 150	(2)	(2)	(2)
Morocco, French	132	163	(2)	(2)	(2)
Netherlands Indies		[4] 500	[4] 753	2, 222	(2)
New Caledonia	11, 600	11, 700	10, 625	9, 733	(2)
Norway	877	1, 245	1, 106	(2)	(2)
Southern Rhodesia	4	76	[4] 490	(2)	(2)
Union of South Africa		44	398	416	(2)
U. S. S. R	2, 000	2, 500	(2)	(2)	(2)
United States [5]	199	377	357	503	[6] 590
	120, 100	115, 500	(2)	(2)	(2)

[1] In addition to countries listed, Japan also produces nickel, but data of output are not available.
[2] Data not yet available.
[3] Excludes small quantity produced in British Columbia.
[4] Estimated.
[5] Byproduct in electrolytic refining of copper.
[6] Includes also a small quantity produced from ore and as a byproduct of talc.

Brazil.—The nickel deposits at São José do Tocantins, State of Goyaz, and at Livramento, State of Minas Geraes, have been described in considerable detail by Wright and Pardee.[5]

The nickel deposit at Jacuba, São José do Tocantins, occurs at an altitude of 800 meters on the west side of Serra do Mantiqueira. An automobile road 2 miles long extends from Jacuba to the mine workings, which are at an elevation of 1,050 meters; cobalt is also being mined. Anapolis, the nearest railroad station, is 220 miles from the mine over a narrow, ungraded road, and at present it is necessary to ferry across the Maranhao River. Estimates of ore reserves range from 20 to 100 million tons. Much work will have to be done before the economic limits of the ore body can be outlined accurately enough to permit making tonnage estimates. Assays of numerous samples show a nickel content ranging from 3 to 12 percent, the average being about 5 percent. Mining conditions are favorable, as gravity can be used both in mining and transporting the ore to the mill. The ore could be mined by open-cut, or the millhole system could be used by mining the ore at the surface into raises to an adit level below, with a bulldozing chamber near the bottom of each raise to reduce the large pieces before loading them into ore cars. As the ore is relatively soft, large tonnages could be mined per man-shift with a low consumption of explosives, power, and timber. One of the immediate problems is concentrating the ore. A reverberatory furnace costing $50,000 was installed at Jacuba to reduce the ore to nickel matte, but the company could not obtain the necessary pyrites or gypsum for its operation. The furnace was designed to burn wood, and charcoal and limestone were to be fed into the furnace with the ore and sulfur or pyrites. Concentration of the ore by flotation and leaching methods is to be studied thoroughly. Both water supply and power for a mill are available from nearby rivers, and there are a number of excellent mill sites in the immediate vicinity, with adequate room for tailings disposal.

The Livramento nickel deposit occurs at an altitude of 1,100 meters and is 225 kilometers north of the port of Angra dos Reis, with which it has a direct railroad connection. The mine is operated by the Companhia de Nickel do Brazil, which produces ferronickel in an electric furnace capable of smelting about 15 tons of ore daily. The nickel content of the ore as mined ranges from 1 to 3 percent. During 1936, 28,000 tons of nickel ore were mined; 18,000 tons of this total were shipped to Germany, 7,000 tons went to the company furnace, and 3,000 tons were left in stock. Mine output for the first 4 months of 1941 totaled 1,667 tons. The company produced 492 metric tons of 20-percent ferronickel from the time that the plant was started (in 1939) through 1940. Output of ferronickel for the first 4 months of 1941 was 153 tons, most of which is reported to have been shipped to Germany. The 1942 production will be sold in Brazil—200 tons to the Companhia Siderurgica Belgo Mineira and the rest to smaller steel plants.

Canada.—Virtually all the Canadian output is derived from the copper-nickel ores of the Sudbury district, Ontario; and two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Although figures are

[5] Wright, C. W., and Pardee, F. G., The Nickel-Cobalt Deposit at São José do Tocantins, State of Goyaz, Brazil: Ms. Rept., June 4, 1941, 22 pp.; The Nickel Deposit at Livramento, Minas Geraes, Brazil: Ms. Rept., June 14, 1941, 10 pp.

not available, the output in 1940 and 1941 surpassed the former record output of 113,053 short tons in 1939.

The International Nickel Co. of Canada, Ltd.,[6] operated its mines, smelters, and refineries continuously, largely upon a 24-hour basis. Production of nickel reached an all-time high, and additional works are being constructed that will increase the output further.

Falconbridge Nickel Mines, Ltd.,[7] attained higher annual levels, in both tonnage treated and in production, in 1941, than in any previous year. Part of the gain was attributed to the installation of some additional equipment in the mill but was accomplished mainly by crowding all units to the limit. Extensive additions have been undertaken in various units of the plant to provide for increased capacity.

Cuba.—According to an announcement by the War Production Board, large deposits of the low-grade ores of northeastern Cuba are to be treated by a complicated chemical and metallurgical process to yield nickel by the Nicaro Nickel Co., a new subsidiary of the Freeport Sulphur Co., which since early 1940 has conducted research on nickel recovery. A pilot plant was put into operation in late August 1941. A 20-million-dollar plant and facilities have been authorized; construction is being financed by Reconstruction Finance Corporation, and the plant will be operated by Nicaro Nickel Co. for the Government.

Finland.—According to the Northern Miner: [8]

It is learned that the Germans have placed the mine [Petsamo] in production of ore at the rate of 300 to 350 tons a day, that this ore is being sent to the Norwegian port of Kirkenes, and from there freighted down the coast to Germany. It is being direct-treated in the former Mond I. G. plant at Frankfurt by a process that recovers perhaps half the nickel content and supplies Germany with refined nickel at the rate of 5 million pounds a year.

New Caledonia.[9]—The largest nickel-producing centers are at Thio on the east coast and Voh and Koné on the west coast, all operated by the Nickel Society, whose large Noumea smelters are on the site of former cobalt smelters erected in 1894. The company also erected smelters, using hydroelectric power, at Yate on the southeast end of the island; these were closed in 1931 when the company amalgamated with the Société Hauts Fourneaux, which was then operating the Noumea smelters. In addition to the Nickel Society holdings, hundreds of mines are owned by individuals, but only a dozen or so of these are working; in 1940 they produced about one-third of the Colony's ore. Some of this ore is bought by the Nickel Society; the rest has been exported to Japan. Before the war, Germany bought nickel ore containing 4.7 percent nickel to mix with her own low-grade ore. Ore containing as low as 3.5 percent nickel was being shipped to Japan up to the end of 1940, when the ban on export came into operation.

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[6] International Nickel Co. of Canada, Ltd., Annual Report, 1941, p. 5.
[7] Falconbridge Nickel Mines, Ltd., 13th Annual Report, 1941, pp. 1-10.
[8] Northern Miner, vol. 27, No. 14, June 26, 1941, pp. 1, 9.
[9] Priday, H. E. L., New Caledonia's Mineral Wealth: Chem. Eng. and Min. Rev., vol. 33, No. 396, September 10, 1941, pp. 369-370.

COBALT

By H. W. Davis

SUMMARY OUTLINE

The consumption of cobalt in the United States, chiefly in the production of high-speed cutting tools and permanent magnets, increased substantially during 1941; as heretofore, most of the demand was supplied by imports, mainly in the form of residues from Belgian Congo. Though comparatively small, domestic production made large proportionate gains in 1941, and most of it was a byproduct of the iron ore mined at Cornwall, Pa. The greater part of the cobalt-bearing residues from Belgian Congo is converted to metal at Niagara Falls, N. Y., and to oxide, sulfate, catalytic salts, or driers at Cincinnati and Cleveland, Ohio; Elizabeth, N. J.; New Brighton, Pa.; and Richmond, Calif. The metal-refining capacity of the Niagara Falls plant is being increased 50 percent. Most of the Canadian cobalt ore imported into the United States is processed to oxide and other commodities at Cincinnati. Cobalt oxide was also produced in 1941 at Wilmington, Del., from cobalt-containing pyrites concentrates recovered from the iron ore mined at Cornwall, Pa. Production of metal at Wilmington is planned for 1942. A mixed oxide of nickel and cobalt was recovered in 1941 from Burmese nickel speiss in a plant at Cleveland.

Domestic quotations for metal in 100-pound lots and for black oxide in 350-pound lots remained unchanged throughout 1941 at $1.50 and $1.84 a pound, respectively. These prices have been in effect since the latter part of October 1939.

General Preference Order M–39, issued by the Office of Production Management on November 4, 1941, placed cobalt ore and residues, metal, and cobalt chemical compounds under an allocations system to insure priority for war uses and also limited deliveries of cobalt chemical compounds for nonmetallic uses to 90 percent of the average amount delivered during the first 6 months of 1941. The order was amended February 7, 1942, to place cobalt in all forms under allocations, to prohibit its use in pigments after May 1, and to restrict nonessential uses further.

PRODUCTION

A considerable quantity of pyrites concentrates containing 1.3 percent cobalt was produced in 1941 by the Bethlehem Steel Co., Bethlehem, Pa. The cobalt is contained in the sulfides that accompany the

magnetite mined at Cornwall, Pa. The Eastern Magnesia Talc Co., Inc., Burlington, Vt., recovered 86 short tons of concentrates in 1941 as a byproduct of froth flotation of talc; 36 tons contained 1.97 percent cobalt and 17.19 percent nickel, and 50 tons contained 0.78 percent cobalt and 10.69 percent nickel. The higher-grade concentrate was sold. Otto F. Schwartz, manager of the Columbia mine near Goodsprings, Nev., sold about 2 tons of concentrate averaging 9.48 percent cobalt. Jonathan Gordon, Tombstone, Ariz., reported production of 10 tons of 12-percent cobalt concentrate at a property near Fort Thomas, Ariz.; a 20-ton mill was installed. The Sullivan Mining Co., Kellogg, Idaho, recovered 66 short tons of residue containing 7.19 percent cobalt at its electrolytic zinc plant in 1941, but none was shipped. Plans are under way to reopen the old Buckeye cobalt mine near Fredericktown, Mo. Sporadic attempts have been made to produce cobalt in the Southeastern Missouri district, where cobalt and nickel occur associated with lead, iron, and copper, but the complexity of the ore presents a problem in metallurgy. According to George F. O'Brien, Ironton, Mo., development and exploratory work is progressing on the high-silica, low-manganese ore deposits in Reynolds and Madison Counties, Mo.; these ores are reported to contain 0.5 to 4.8 percent cobalt oxide, and work is under way on a process for recovering the cobalt. Experimental work on electrowinning of cobalt from ores is described in Report of Investigations 3600.[1]

FOREIGN TRADE[2]

Although figures on imports in 1941 are available for publication for only the first 9 months of the year, the partial total is only about 17 percent less than the all-time record established in 1940. Of the partial 1941 imports, Belgian Congo supplied 80 percent in the form of residues (averaging 41 percent cobalt) and Canada 5 percent as ore (averaging 9 percent cobalt) and 14 percent as metal. Data on exports are not given by the United States Department of Commerce.

Cobalt ore, metal, oxide, and other compounds of cobalt imported for consumption in the United States, 1937–41

Year	Ore			Metal		Oxide		Sulfate		Other salts and compounds	
	Pounds										
	Gross weight	Cobalt content	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1937	587,499	(1)	$44,352	1,073,129	$1,341,928	842,847	$1,059,432	56,540	$21,858	45	$187
1938	449,984	(1)	32,354	938,476	1,146,559	373,215	519,201	41,811	18,277	56	98
1939	611,083	(1)	54,446	2,130,296	2,711,677	680,644	944,836	75,290	34,343	1,374	3,405
1940	10,497,719	(1)	3,660,869	130,321	207,345	756,759	1,124,554	11,468	7,818	------	-----
1941 (2)	8,647,797	2,893,138	3,137,756	484,800	738,378	38,002	55,120	4,480	3,779	500	885

(1) Data not available.
(2) January to September, inclusive.

[1] Dean, R. S., Progress Reports—Metallurgical Division. 50. Annual Report of the Metallurgical Division, Fiscal Year 1941: Bureau of Mines Rept. of Investigations 3600, 1941, pp 42–44

[2] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Cobalt ore, metal, and oxide imported for consumption in the United States, 1940–41, by countries, in pounds

Country	Ore			Metal		Oxide	
	1940	1941 [1]		1940	1941 [1]	1940	1941 [1]
	Gross weight	Gross weight	Cobalt content				
Australia		56,224	1,000			16,800	
Belgian Congo	7,843,828	6,631,692	2,718,473				
Belgium				100,321		488,619	17,850
Canada	2,653,891	1,959,881	173,665	30,000	484,800	177,450	15,952
Finland						21,200	
France						52,690	
United Kingdom							4,200
	10,497,719	8,647,797	2,893,138	130,321	484,800	756,759	38,002

[1] January to September, inclusive.

USES

An important use for cobalt is in the manufacture of high-speed cutting tools for operation at high speeds or at high temperatures. It also is employed in alloy steels for high-temperature dies, heavy-duty shears, and other implements requiring extreme toughness combined with great hardness at high temperatures. The largest single use of cobalt is in stellite or stellite-type alloys, which contain 45 to 55 percent cobalt, 30 to 35 percent chromium, and 12 to 17 percent tungsten; there are various modifications of this composition, but all contain high percentages of cobalt. A comparatively small quantity of cobalt is used in carbide-type alloys. A substantial quantity of cobalt is used in permanent magnets, which are employed in electric meters, relays, regulating devices, fractional horsepower motors and generators, switching appliances, and a variety of other uses. Cobalt is also employed in alloys where constant magnetic permeability at low magnetic forces is necessary. Comparatively small quantities of cobalt are used in electroplating and as a catalyst. Cobalt oxide is utilized in the ceramic industry; and cobalt salts are employed in the preparation of driers for use in paints, varnishes, and linoleums and as a catalyst.

WORLD PRODUCTION

Because cobalt-production data published by many of the producing countries are given in such indefinite figures and because those for certain countries are lacking, it is impossible to prepare an accurate statement of world output. Despite the fact that cobalt has been reported produced in about 14 countries, Belgian Congo, Burma, Canada, French Morocco, and Northern Rhodesia have in recent years supplied the bulk of the production, which increased from about 1,200 metric tons in 1929 to 4,500 to 5,000 tons in 1939.

Brazil.[3]—The Empresa Brasileira Mineracão Ltda. of São Paulo, a Japanese organization, was established by decree 4882 on November 16, 1939. The shares in the company were held by Brazilian-born citizens who were in the employ of the company and constitute the Board of Directors. The real owners, as well as the men in charge

[3] Wright, C. W., and Pardee, F G., The Nickel-Cobalt Deposit at São José do Tocantins, State of Goyaz, Brazil: Ms. Rept., June 4, 1941, pp. 15–16.

of operations at the mine, were Japanese. After several months of investigation the company signed a contract with the Empresa Commercial of Goyaz, S. A., on October 28, 1940, to obtain the privilege of mining cobalt ore over a period of 7 years and to pay for the ore extracted upon a basis of 50$000 a metric ton for ore with 3 percent cobalt, plus 10$000 for each additional 0.1 percent. Thus, ore containing 4.5 percent cobalt would bring 200$000 a ton, or $10 in United States currency. Under the contract, all operating expenses and construction and upkeep of roads from the mine at Anapolis were to be paid by the Empresa Brasileira Mineracão Ltda. During the first 5 months of 1941, cobalt ore produced totaled 141 tons. In the early part of 1941, a plant with trommels, sorting belts, and cleaning drums was being built which was expected to increase daily production capacity to about 10 tons. Mining operations were confined to the Jacuba II section, where the ferruginous capping of the serpentine was being excavated for its cobalt content. This area of capping, was about 500 meters long, 200 meters wide, and less than 1 meter to several meters thick (the average being about 1.5 meters). This capping is excavated by pick and shovel and transported in wheelbarrows to screens, where fines under ⅜-inch are screened out. The oversize material is sorted into medium-, high-, and low-grade piles. Only the high-grade ore was transported in automobile trucks to the washing plant below the Jacuba camp. Twenty-five men were employed at the mine, and about 50 tons of material were handled daily. At the washing plant, 2 kilometers from the mine, the ore was washed and sized in a trommel. Ore larger than 1 inch went to sorting tables where the higher-grade ore was separated, about 20 percent being discarded. Ore less than 1 inch went to a cleaning drum about 1 meter in diameter and 1 meter in length, into which the ore was dumped in batches, with an equal amount of quartz sand, and rolled for several minutes to remove the iron oxide coating on the surface of the small pieces. Loss of cobalt ore due to abrasion by this treatment was estimated at 5 to 10 percent. The final product contains 4 to 4.5 percent cobalt, which was shipped to Japan in bags holding 100 pounds.

Canada.—As a result of improved demand, activity in the Cobalt district, Ontario, increased. Over 50 properties are being worked for silver and cobalt.[4] The many small leasers in the Cobalt camp suffered a severe handicap when the plant of Temiskáming Testing Laboratories (Ontario Government sampling plant) was destroyed by fire in July 1941.[5] Leasers depended on the plant for the sampling valuation, and frequently the marketing of their ore.

Chile.—During November 1941, Chile shipped 525 metric tons of cobalt ore to Japan. The Compañiá Minera "La Cobaltera," which operates a cobalt deposit near Puerto del Huasco in the Province of Atacama, suspended operations temporarily to install a concentrating plant and make other necessary improvements; regular production is not expected to be resumed until the improvements are completed, probably in 1942. The Cobalt Minerals Corporation has been formed to exploit cobalt deposits in Chile.[6] Although the deposits, so far as known, are not particularly extensive, it is reported that up to 600 tons of concentrates averaging 10 to 12 percent cobalt could be produced annually.

[4] Skillings' Mining Review, vol. 30, No. 4, May 17, 1941, p. 9.
[5] Canadian Mining Journal, vol 63, No. 1, January 1942, pp. 54, 56.
[6] Metal Bulletin (London), No. 2564, January 31, 1941, p. 11.

MOLYBDENUM AND VANADIUM

By FREDERICK BETZ, JR., AND A. P. VAN SICLEN [1]

SUMMARY OUTLINE

MOLYBDENUM

SUMMARY

Domestic production of molybdenum reached a new peak in 1941, with a total of 40,162,000 pounds (contained molybdenum), or 17 percent above the previous peak of 34,313,000 pounds in 1940. Fragmentary data with respect to production elsewhere in the world indicate that Latin American countries continued to produce a few hundred tons of molybdenum. What transpired in most molybdenum-producing countries may only be surmised, but in general the record of molybdenum centers around developments in the United States.

As actual or threatened shortages of strategic metals employed in steel alloying developed, molybdenum became increasingly important in the defense program, and its use was regulated in a series of orders issued by the Office of Production Management.

In 1941, as in 1940, shipments of molybdenum concentrates from the United States to foreign countries represented about 19 percent of domestic production, compared with 67 percent in 1939. Most of the 7,673 short tons of molybdenum ore and concentrates exported (valued at $5,379,367) went to the United Kingdom and U. S. S. R.

As has been the case for a number of years, the Climax Molybdenum Co. was the world's leading producer of molybdenum, and in 1941 it supplied 69 percent of the domestic output. Molybdenite concentrates recovered as a byproduct of copper operations at Bingham, Utah, Santa Rita, N. Mex., and Miami, Ariz., have become an established source of supply and in 1941 represented 28 percent of the United States production of molybdenum.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Salient statistics of the molybdenum industry in the United States, 1939–41

	1939	1940	1941
Concentrates			
Production short tons	32,347	33,128	38,962
Molybdenum contained pounds	30,324,000	34,313,000	40,162,000
Shipments (including exports) short tons	31,479	24,300	36,894
Molybdenum contained			
Average percent	51.49	52.12	51.77
Total pounds	32,415,000	25,329,000	38,200,000
Value [1]	$22,157,000	$17,189,000	$25,883,000
Exports short tons	21,777	6,339	7,673
Molybdenum contained pounds	(2)	6,584,714	7,640,330
Value	$14,066,501	$4,904,000	$5,379,367
Imports for consumption (molybdenum contained):			
Pounds	26,347		4,300
Value	$32,327		$2,898

[1] Estimated by Bureau of Mines.
[2] Not recorded.

DEFENSE PROGRAM

Recognition of the possibilities of using molybdenum in place of tungsten is by no means recent. References cited by Gregg [2] indicate that early in the twentieth century a number of investigators were studying the properties of molybdenum as a steel-alloying element and its effective value in replacing tungsten for such use. Anticipating the possibility that imports of tungsten might be curtailed, several steps were taken by Federal defense agencies during 1941 to promote the use of molybdenum as a substitute material. The Advisory Committee on Metals and Minerals of the National Academy of Sciences submitted a report in April 1941 indicating that molybdenum high-speed steels can be substituted for tungsten steels "rather sweepingly if the necessity arises."

Molybdenum was one of 16 metals included in O. P. M. General Metals Order 1, issued May 1, 1941, to which inventory control was applied. The order provided that the metals affected might not be shipped to customers in quantities that would increase customers' inventories to unnecessary levels. The 16 metals were then placed on the Priorities Critical List. (General Metals Order 1 was extended to October 15, 1941, and subsequently revoked.)

On June 12, 1941, General Preference Order M-14 was issued, which provided that a customer for high-speed steel might not purchase the tungsten-type steel (containing more than 12.0 percent tungsten) if the molybdenum type (7.0 percent or less tungsten and more than 3.0 percent molybdenum) would serve as well. It provided further that during any 3-month period, beginning June 1, 1941, a customer for high-speed steel might purchase tungsten-type steel only to the extent that he bought molybdenum-type steel.

Early in December the foregoing order was amended to provide that 75 percent of all high-speed-steel orders accepted in any one quarter should be of the molybdenum type and not more than 25 percent of the tungsten type. The order was also extended to December 31, 1942.

As a result of the increased use of molybdenum in replacing tungsten in alloy steels, the War Production Board issued General Preference Order M-110 on March 18, 1942, providing for complete alloca-

[2] Gregg, J. L., The Alloys of Iron and Molybdenum. McGraw-Hill Book Co., Inc., New York, 1932, 507 pp.

tion of molybdenum in all forms, including scrap, until December 31, 1942. Provisions of the order were to become effective May 1, 1942.

PRICES

Engineering and Mining Journal quotations for 90 percent molybdenum concentrates remained constant at 45 cents per pound throughout the year. Ferromolybdenum containing 55 to 60 percent Mo was quoted at 95 cents per pound of Mo, f. o. b. shipping point, throughout the year; prices for calcium molybdate at 80 cents per pound of Mo contained and molybdenum metal (99 percent) at $2.60 to $3.00 per pound were also constant.

DOMESTIC PRODUCTION

The spectacular development of the molybdenum industry from the first year of World War I to the end of 1941 is shown in the following table.

Molybdenum in ore and concentrates shipped from mines in the United States, 1914–41

Year	Pounds	Value [1]	Year	Pounds	Value [1]
1914	1,297	$1,297	1928	3,329,214	$1,924,600
1915	181,769	114,866	1929	3,904,648	2,259,000
1916	206,740	205,000	1930	3,759,269	2,068,000
1917	350,200	495,350	1931	3,157,000	1,577,000
1918	861,637	1,253,700	1932	2,373,000	1,186,000
1919	297,926	341,814	1933	5,761,000	4,316,000
1920	34,900	17,207	1934	9,377,000	6,502,000
1921			1935	10,892,000	7,261,000
1922			1936	17,959,000	11,933,000
1923	22,667	11,350	1937	30,122,000	20,571,000
1924	297,174	222,880	1938	25,727,000	17,977,000
1925	1,154,050	961,324	1939	32,415,000	22,157,000
1926	1,431,830	1,192,714	1940	25,329,000	17,189,000
1927	2,286,075	1,858,786	1941	38,200,000	25,883,000

[1] Largely estimated by Bureau of Mines.

Arizona.—Among the smaller domestic producers of molybdenum is Mammoth-St. Anthony, Ltd., operating at Tiger, Pinal County. In addition to molybdenum, the values recovered are gold, silver, lead, and vanadium. Huttl [3] has recently summarized the operations, stating that: "The enterprise is essentially a low-grade gold mine, with a large daily tonnage and careful management as the principal requisites for making the ore bodies economically important." The molybdenum ore is wulfenite ($PbMoO_4$). Over-all recovery of molybdenum in the Mammoth-St. Anthony operation is 97 percent in the mill and 74 percent in the smelter. The smelter has a daily capacity of about 20 tons. The slag containing the molybdenum and vanadium values is treated further, yielding a Na_2MoO_4–$Na_2V_2O_4$ salt, which is shipped. The Miami Copper Co. continued to recover molybdenum as a byproduct of copper-mining operations at Miami, Gila County. A roaster converts the molybdenite concentrates to molybdic oxide.

California.—The United States Vanadium Corporation completed a new concentrating and chemical treatment plant near its tungsten

[3] Huttl, John B., Mammoth-St Anthony's Complex Operations Eng and Min. Jour, vol 142, No. 12, December 1941, pp. 42-45.

mine on Pine Creek near Bishop, Inyo County. The new plant, with an initial capacity of 1,300 tons of tungsten-molybdenum ore a day, replaced a 450-ton plant at the mine. Burwell [4] has described the milling process and metallurgical problems encountered in developing this operation. Molybdenum is one of the byproducts, which include also copper, silver, and gold. The molybdenum minerals in the ore are molybdenite, molybdite, and powellite.

Colorado.—In 1941, production by the Climax Molybdenum Co. increased nearly 22 percent to 27,751,273 pounds of elemental molybdenum. Except for the record high output attained in 1938, this production was the greatest since the company began mining in 1918. Production of molybdenum from the Climax deposit from 1918 to 1941 has been as follows:

Molybdenum (element) contained in concentrates produced from the Climax deposit in Colorado, 1918–41

	Pounds		*Pounds*
1918	342, 200	1930	3, 083, 000
1919	152, 648	1931	2, 644, 399
1920	----------	1932	1, 913, 395
1921	----------	1933	5, 028, 695
1922	----------	1934	8, 378, 683
1923	----------	1935	10, 168, 635
1924	156, 935	1936	15, 216, 806
1925	821, 757	1937	22, 750, 368
1926	1, 057, 367	1938	28, 242, 085
1927	1, 858, 228	1939	21, 796, 116
1928	2, 957, 845	1940	22, 782, 608
1929	3, 529, 295	1941	27, 751, 273

The following excerpts from a recent article by Duggan [5] trace the history of this unique operation:

The mine and mill of the Climax Molybdenum Co. are at Climax, Colo., on Fremont Pass, directly on the Continental Divide, at an elevation of 11,400 feet.

The Climax ore-bearing rock is essentially an altered and highly silicified granite, fully half of the gangue being quartz. Molybdenite is the only mineral of economic consequence, and most of it is intimately associated with quartz in the form of fine veinlets and stringers. Other minerals are molybdite, pyrite, and chalcopyrite. While the molybdite may be readily extracted by hydrometallurgical methods, its content is too low to make such operations profitable. The pyrite content ranges from 2 to 5 percent and that of the chalcopyrite from 0.03 to 0.05 percent. There is not enough copper to make its recovery attractive, and one of the metallurgical problems is the elimination of it and the pyrite from the product.

On account of the close association of the molybdenite with the quartz and the necessity of eliminating the pyrite and chalcopyrite from the final product, fine grinding followed by flotation is the only feasible method of concentration.

Construction of the first milling unit was started in 1917, and it was operated during parts of 1918 and 1919.

In the post-war years, there was almost no demand for the product and production was at a standstill until 1924. The company's research campaign to develop the use of the metal began to show results in that year. From 1926 to 1932 production ranged from 500 to 1,200 tons per day. In 1931 an additional mill section was built, and production was gradually increased until in 1934 and 1935 about 3,000 to 4,000 tons was milled per day. This tonnage overtaxed the milling facilities, and as the demand for molybdenum was growing constantly, additional milling equipment was needed. In 1936 and 1937 another crushing plant, six additional mill sections, and the necessary auxiliary plants were constructed and brought into operation.

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[4] Burwell, Blair, Milling Tungsten Ores at Pine Creek: Min. Cong. Jour., vol. 27, No. 10, October 1941, pp. 16–18.

[5] Duggan, E. J., Climax Milling Practice: Am. Inst. Min. and Met. Eng., Tech. Paper 1456, Min. Technol., March 1942, 15 pp.

This plant was designed to mill 10,000 tons per day, but it was not long before 12,500 tons was being treated during periods of peak demands. During the summer of 1941, to meet defense needs, the mill has been required to treat 15,500 tons per day. This has been accomplished with little plant expansion and at no loss in recovery. To increase capacity still further, one more primary section is being built. This will bring capacity to 18,000 tons per day, which can be stretched to 20,000 tons at a small sacrifice in recovery.

The foregoing article also describes milling methods in considerable detail; additional information on mining methods, with special reference to blasting practice, was made available by Barker.[6]

New Mexico.—The Molybdenum Corporation of America continued to operate its mine and mill near Questa, Taos County. Ore of relatively high grade is mined, and the tonnage treated is comparatively small. The Nevada Consolidated Copper Corporation recovered molybdenite as a byproduct from its copper concentrate at the Chino property in Grant County.

Utah.—The only producer in Utah in 1941 was the Utah Copper Co. at Bingham. The molybdenite concentrate is obtained as a byproduct in the concentration of copper ores and in the re-treatment of molybdenum-bearing concentrates.

EXPORTS AND IMPORTS

Total exports of molybdenum ore and concentrates in 1941 were 15,345,251 pounds, containing 7,640,330 pounds of molybdenum, with a value of $5.379,367; this total represents a 16-percent increase over 1940 in molybdenum contained. Large increases were shown in shipments in 1941 to Canada, U. S. S. R., and United Kingdom. Exports of molybdenum to France, Italy, and Japan ceased. Chile entered the list of countries receiving molybdenum from the United States, whereas no exports to Brazil were recorded during 1941.

Molybdenum ore and concentrates exported from the United States, 1940–41, by countries

Country	1940			1941		
	Gross weight (pounds)	Molybdenum content (pounds)	Value	Gross weight (pounds)	Molybdenum content (pounds)	Value
Brazil	332,676	201,362	$149,856			
Canada	554,951	284,458	255,256	974,321	500,402	$400,706
Chile				30,255	15,000	12,000
France	5,299,380	2,740,065	2,021,685			
Italy	1,650,650	849,578	631,696			
Japan	133,215	117,100	53,929			
U. S. S. R.	654,789	336,289	241,113	4,715,284	2,367,492	1,777,185
United Kingdom	3,985,961	2,019,801	1,514,852	9,625,391	4,757,436	3,189,476
Other countries	66,172	36,061	35,613			
	12,677,794	6,584,714	4,904,000	15,345,251	7,640,330	5,379,367

Imports of molybdenum in molybdenum ore and concentrates in 1941 totaled 4,300 pounds; there were none in 1940. In 1939, 26,347 pounds were imported in ferromolybdenum, etc.

[6] Barker, Claude L., The World's Largest Molybdenum Mine: Mines Mag., vol. 31, No. 11, November 1941, pp. 558–564, 568.

Molybdenum ore and concentrates, ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum imported for consumption in the United States, 1937–41

Year	Molybdenum content (pounds)	Value	Year	Molybdenum content (pounds)	Value
1937	7,707	$13,491	1940		
1938	25	81	1941	4,300	$2,898
1939	26,347	32,327			

USES

Approximately 93 percent of the molybdenum consumed in the United States is employed in steel ingots and castings; 3 or 4 percent goes into iron castings; and the remainder is used in miscellaneous products, such as pigments and colors, welding rods, etc. Molybdenum is becoming of increasing interest as a substitute material for tungsten and other steel-alloying metals, of which domestic supplies are limited. Its chief field of usefulness in this capacity is to replace tungsten, as mentioned elsewhere in this chapter. However, the Advisory Committee on Metals and Minerals of the National Research Council has called attention to the value of molybdenum in relieving threatened shortages of vanadium, caused by substitution of the latter for nickel.[7]

A tabulation of 1,500 tool steels compiled by Lippert [8] includes more than 250 with molybdenum contents ranging from as little as 0.15 percent to the molybdenum high-speed steels, which may be as high as 9 percent Mo. Increased use of molybdenum-type high-speed steels has been facilitated by release of patents covering their production by several companies holding them.

For use in alloy steels, molybdenum may be added in the form of ferromolybdenum, calcium molybdate, and molybdenum oxide (roasted molybdenite). Common practice favors use of the oxide, and nearly half of the molybdenum employed in alloy steels enters in that form.

As was to be expected, compliance with O. P. M. orders substituting molybdenum-type high-speed steels for tungsten high-speed steels presented certain technical difficulties, which are being solved as rapidly as possible. Recommendations concerning the handling of molybdenum high-speed steels were made by a special committee of O. P. M.[9]

According to Edsall and Lloyd,[10] solution of a major problem—that of heat treating—may be achieved through use of the electrically heated salt bath. Procedure to be followed in salt-bath hardening

[7] Steel, Finds Molybdenum Good Substitute to Relieve Tightness in Vanadium: Vol. 109, No. 17 October 27, 1941, p. 86.

[8] Lippert, T. W., 1500 Tool Steels. Iron Age, vol 147, No. 20, May 15, 1941, pp 55–59; No. 21, May 22, pp. 65–68; No. 22, May 29, pp. 51–54, No 23, June 5, pp. 60–63, No. 24, June 12, pp. 65–68, No. 25, June 19, pp. 58–60, No 26, June 26, pp. 52–54 vol 148, No. 1, July 3, 1941, pp. 56–59

[9] Stotz, N I., and others, Heat Treatment of Molybdenum High-Speed Steels: Am. Metal Market, vol. 48, No 175, September 10, 1941, p 7.

[10] Edsall, Howard Linn, and Lloyd, T. E., Heat-Treating High-Speed Molybdenum Steels: Iron Age, vol. 148, No. 14, October 2, 1941, pp 39–46.

of molybdenum high-speed steels was also described in the report of a special committee of O. P. M. headed by A. F. Holden.[11]

Another O. P. M. committee report[12] presents details of surface protection of molybdenum high-speed steels through use of controlled-atmosphere furnaces.

A molybdenum stainless steel has been developed that is said to have great strength and freedom from chemical or electrical reaction and to be adapted to treatment of bone fractures. It may be used in the form of steel plates, screws, nails, and wire in surgery, and the manufacturer claims that it provides bone surgeons with a strong, durable metal that will not corrode in human tissues.[13]

British practice in use of molybdenum in "high-strength" iron was reviewed by A. McRae Smith,[14] who stated that "in correctly balanced proportions, added to a suitable base composition, nickel and molybdenum impart to cast iron the maximum tensile and transverse strengths and deflection so far achieved in any material which is a true gray cast iron."

Minor outlets for molybdenum include its use in pigments and colors, welding rods, and wire and for various chemical purposes. Such uses, however, represent specialized fields in which relatively few manufacturers participate. Applications for black molybdenum finishes are described by Young,[15] who mentions jewelry, instrument-gage dial, and decorative fields. Colors ranging from rainbow effects to black deposits may be obtained with coatings produced in a solution containing ammonium molybdate, sodium thiosulfate, and some ammonium hydroxide. Molybdenum black coatings may be applied to electroplated zinc and cadmium, die-cast zinc, die-cast aluminum, and rolled aluminum.

TECHNOLOGIC DEVELOPMENTS

A sample of wulfenite (lead molybdate) ore from Arizona was tested in the Ore-Dressing Section of the Metallurgical Division of the Bureau of Mines at Rolla, Mo., to determine whether molybdenum-bearing concentrates could be obtained by gravity-concentration methods avoiding formation of slime and attendant loss of value. The investigators concluded that careful stage-crushing is essential to avoid excessive sliming and that with efficient hydraulic classification and table concentration good recovery of the valuable mineral should result.[16]

WORLD PRODUCTION

The production of molybdenum outside the United States is very small. Figures covering such output in 1941 are available only for Chile, Mexico, and Peru; except for Norway, these countries appear to be the only significant foreign sources of supply.

[11] Holden, A. F., and others, Salt-Bath Method for Hardening Molybdenum High-Speed Steels. Am. Metal Market, vol. 48, No 175, September 10, 1941, p. 7

[12] Hayes, G I., and others, Controlled-Atmosphere Furnaces for the Heat Treatment of Molybdenum High-Speed Steels· Am Metal Market, vol. 48, No. 175, September 10, 1941, p. 7

[13] American Metal Market, Republic Steel Develops New Steel for Surgery Vol 48, No. 157, August 14, 1941, p. 1.

[14] Mining Journal (London), Molybdenum in Cast Iron· Vol 214, No. 5528, August 2, 1941, p. 366.

[15] Young, C. B. F , Plating Alloys· Iron Age, vol 149, No. 7, February 12, 1942, pp. 53–57.

[16] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 45. Ore-Testing Studies, 1939–40: Bureau of Mines Rept. of Investigations 3564, 1941, p. 23

World production of molybdenum ores and concentrates, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Australia:					
New South Wales..concentrates (gross weight)..	16	9	(2)	(2)	(2)
Queensland........do....	23	14	20	(2)	(2)
Victoria........do....	31	36	26	(2)	(2)
Western Australia........do....	(2)	(2)	64	(2)	(2)
Canada........do....	7	6	1	(2)	(2)
Chile........concentrates (Mo content)..	....	....	30	267	229
Greece........ore (gross weight)..	....	1, 560	(2)	(2)	(2)
Italy........do....	46	12	(2)	(2)	(2)
Mexico........concentrates (Mo content)..	629	483	523	310	522
Morocco, French (exports)........do....	104	94	(2)	(2)	(2)
Norway........do....	344	462	433	(2)	(2)
Peru........do....	50	85	167	190	148
Rumania........Bi-Mo ore (gross weight)..	27	160	(2)	(2)	(2)
Turkey........concentrates (Mo content)..	26	41	(2)	(2)	(2)
United States........do....	13, 344	15, 103	13, 755	15, 564	18, 217
Yugoslavia........ore (gross weight)..	84	19	60	(2)	(2)

[1] In addition to the countries listed, molybdenum ore is also produced in Burma, China, Chosen, and Japan, but data on production are not available.
[2] Data not available.

In Canada, the Moss mine, in the Quyon district of Quebec, controlled by the Quyon Molybdenite Co., was active during the latter part of 1941. Operation of the mine was undertaken during the first World War by The Canadian Wood Molybdenite Co.; subsequently the property changed hands several times and was worked intermittently. The present management took charge in 1938 and has built a mill and smelter. Output was reported to be at the rate of about 6 tons of 90-percent concentrates a week, and ore reserves were estimated at 30,000 tons averaging 0.5 percent MoS_2. Production of molybdenum in Chile, where molybdenite concentrates are recovered from copper operations of the Braden Copper Co. at Sewell, amounted to 229 metric tons (Mo content) in 1941. In January 1942 the Government of Chile entered into an agreement granting the United States exclusive buying rights on all molybdenum produced in Chile for 18 months. Peru Molibdeno, S. A., principal producer in Peru, continued to operate its mine near Ricran, in Juaja, Department of Junin. With the expiration of contracts for shipments of molybdenum to Japan, all future exports were destined for England. Discovery of a molybdenum deposit was reported in Salvador [17] 8 km. east of the village of Teputla, Department of Chalatenango, and 40 km. from La Toma, the nearest railway point. Prospecting revealed a 4- to 5-foot vein in a 30-foot shaft; ore samples were reported to contain 8.5 to 19 percent MoS_2.

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[17] Engineering and Mining Journal, Molybdenum Deposit in San Salvador. Vol. 142, No. 7, July 1941, p. 85.

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VANADIUM

SUMMARY

In 1941 the United States became the world's leading producer of vanadium, displacing Peru which held that position from 1938 to 1940. Domestic production, in terms of vanadium contained in ore distributed to mills and domestic consumers, amounted to 2,393,478 pounds (1,086 metric tons) in 1941 compared with 2,162,916 pounds (981 metric tons) (revised figures) in 1940. Peru's production decreased from 1,214 metric tons (vanadium contained) in 1940 to 1,017 tons in 1941. A marked decline was noted in the vanadium output of South-West Africa. No statistics are available concerning production in Northern Rhodesia. The demand for vanadium in the United States has increased steadily. Apparent consumption in 1940 was estimated at 3,000,000 pounds by the Office of Production Management, which on August 16, 1941, stated that "The current rate of production would indicate that 3,750,000 pounds in finished form will be made available in 1941 as against an estimated need of 5,900,000 pounds. Requirements for 1942 are expected to reach 7,150,000." Vanadium was placed under full priority control on August 14. On December 20, a complete allocation system was established for vanadium by the O. P. M.

The only countries known to have important vanadium-ore deposits are the United States, Peru, South-West Africa, and Northern Rhodesia. Vanadium has been and is now being obtained by some countries from other materials, including petroleum, bauxite, phosphate rock, and titaniferous magnetites. The ever-increasing demand for vanadium directs attention to all possible vanadium resources, as well as to efforts to extend known deposits.

In the United States the principal ores are roscoelite and carnotite in sandstones, disseminated or in spots, bunches, lenses, and seams. These desposits, representing a distinct type, are found in southwestern Colorado and in southeastern Utah. Application of geophysical methods in this region to locate further concentrations of ore was discussed by Kelly.[18]

[18] Kelly, S. F., Geological Studies of Vanadium-Uranium Deposits by Geophysical Exploration Methods: Min. Cong. Jour., vol. 27, No. 8, August 1941, pp. 27-35.

Interest was shown in lead vanadate deposits in the western United States. Under normal conditions, these deposits do not have commercial value, but the Metals Reserve Co. reported that arrangements had been completed for rapid development of several such properties to augment the domestic vanadium supply.

The Bureau of Mines investigated the metallurgical treatment of vanadium ores (including carnotite, cuprodescloizite, descloizite, and vanadinite) from Colorado, Nevada, and Arizona.[19]

Vanadium was recovered from flue dust gathered from the boilers of ships burning Venezuelan fuel oil. The dust is said to contain 20 to 40 percent V_2O_5. Lately, Argentine petroleum and asphaltite have been examined for their vanadium content. The investigators, Fester, Cruellas, and Baron,[20] state that the oils contain vanadium in quantities too small to be recovered economically. Referring to the asphaltites, these authors find that, whereas Peruvian bituminous material contains 0.5 to 1.5 percent V_2O_5, the samples from the Provinces of Mendoza and Neuquén, Argentina, contained only 0.1 to 0.2 percent. In 8 of 24 analyses given the content was below 0.1 percent.

The presence of vanadium in titaniferous magnetites is well-known. Actual recovery from converter slag has been carried on in Germany, where, it is believed, this source meets the vanadium requirements of that country. Research on recovery of vanadium from slags is reported from U. S. S. R. In a recent study of the titaniferous magnetites of the Laramie Range, Wyoming, Diemer[21] gives six new analyses in which the V_2O_3 content ranges from 0.32 to 0.53 percent. Frankel and Grainger[22] report 1.08 percent V_2O_3 in a sample of titaniferous iron ore from the Bushveld Complex of South Africa and note that the content of all samples examined thus far rarely exceeds 1 percent V_2O_3. They concur in the results of investigations in India by Dunn and Dey[23] who found that the vanadium is present in coulsonite, a mineral possibly of the composition $(FeV)_2O_3$. Frankel and Grainger believe that the intimate association of the minerals in the Bushveld ore, presumably a typical titaniferous iron ore, would militate against successful concentration of any of its constituents by physical methods.

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[19] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 45 Ore-Testing Studies, 1939-40: Bureau of Mines Rept of Investigations 3564, 1941, pp. 5-12.
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[20] Fester, G. A., Cruellas, J., and Baron, M., Cenizas vanadiferas: Rev Facultad de Quim., Ind., y Agric., vol. 8, Univ. Nac. del Litoral, Santa Fe, Argentina, 1940, pp. 95-110.

[21] Diemer, R. A., Titaniferous Magnetite Deposits of the Laramie Range, Wyoming: Geol. Surv. Wyoming Bull. 31, 1941, 23 pp

[22] Frankel, J. J, and Grainger, G. W, Notes on Bushveld Titaniferous Iron Ore. South African Jour. Sci., vol 37, 1941, pp. 101-110.

[23] Dunn, J. A., and Dey, A K., Vanadium-Bearing Titaniferous Iron Ores in Singhbum and Mayurbhanji, India: Trans. Min Geol Inst India, vol. 41, pt. 3, 1937, pp 117-184.

Salient statistics of vanadium-bearing ores in the United States, 1940–41

	1940	1941
Mine production:		
Vanadium ores ... short tons	95,983	135,822
Vanadium contained ... pounds	2,879,379	2,333,797
Uranium-vanadium ores ... short tons	790	906
Vanadium contained ... pounds	51,377	50,824
Complex ore:		
Vanadium contained ... do	95,810	105,760
Distribution:		
Ore milled:		
Vanadium ores ... short tons	95,549	111,602
Vanadium contained ... pounds	2,015,729	2,236,894
Complex ore:		
Vanadium contained ... do	95,810	105,760
Ore shipped to domestic consumers:		
Uranium-vanadium ores ... short tons	796	• 908
Vanadium contained ... pounds	51,377	50,824
Total distribution:		
Vanadium contained ... do	[1] 2,162,916	2,393,478
Value	[1, 2] $1,044,100	[2] $1,098,500
Mill products [3] (vanadium contained):		
Produced—		
From vanadium and uranium-vanadium ores ... pounds	1,496,257	1,681,192
From other ores ... do	[4] 51,876	[5] 172,463
Total produced ... do	1,548,133	1,853,655
Shipped—		
From vanadium and uranium-vanadium ores ... do	1,180,607	[6] 2,026,752
From other ores ... do	[4] 23,495	[4] 26,134
Total shipped:		
Vanadium contained ... do	1,204,102	2,052,886
Value	[2] $2,350,500	[2] $3,968,800
Imports:		
Vanadium ores ... short tons	22,551	12,323
Vanadium contained ... pounds	2,574,951	2,138,608
Value	$1,216,705	$1,012,991
Exports:		
Vanadium ore and concentrates ... short tons	(7)	28
Vanadium contained ... pounds	(7)	25,462
Value	(7)	$63,218

[1] Revised figure.
[2] Estimated by Bureau of Mines
[3] Vanadium oxide, vanadic acid, and iron vanadate.
[4] Mill products produced from complex ore.
[5] Mill products produced from complex ore and phosphate rock
[6] Includes shipments of mill products produced from phosphate rock.
[7] Data not available.

DEFENSE PROGRAM

Vanadium was among the metals included in the inventory control provided by General Metals Order 1, May 1, 1941, issued by the Office of Production Management. It was removed from this order on August 14 and placed under full priority control, effective September 1. The new regulation (Order M–23) gave high ratings to all defense orders for vanadium and required their acceptance in preference to nondefense orders; a purchaser of vanadium was required to file a statement of the intended uses not later than the twenty-fifth of the month preceding that specified for delivery; deliveries were restricted to an amount not in excess of that necessary to fill a given manufacturer's orders on the basis of his current method and rate of production. On December 20, General Preference Order M–23–a replaced the previous priority-control order. It "provides for monthly requests for vanadium allotments and authorizes the Director of Priorities to make monthly allocations without regard to previous

preference ratings." Consumers receiving less than 50 pounds a month are not obliged to file reports. The order, as originally announced, was to be effective until June 30, 1942.

Vanadium was among 13 materials listed in General Imports Order M-63, which took effect December 28, 1941. The order provided that "unless otherwise authorized by O. P. M., all future contracts for imports of these materials will be handled by the Metals Reserve Co., R. F. C. subsidiary, or other governmental agency. No private person or concern can make arrangements for imports, except that in certain cases, such as imports for processing and immediate re-export, the Director of Priorities may grant specific exceptions to the Order." The Metals Reserve Co. was stated to be planning to work through established brokers and dealers.

PRICES

Engineering and Mining Journal Metal and Mineral Markets quoted a nominal price of 27½ cents per pound of V_2O_5 contained for vanadium ore throughout 1941. Ferrovanadium was quoted at \$2.70 to \$2.90 per pound of V contained, and the price of vanadium pentoxide (technical grade, approximately 88 to 92 percent V_2O_5) quoted by Daily Metal Trade was \$1.10 per pound of V_2O_5 contained.

DOMESTIC PRODUCTION

Arizona.—Vanadium is recovered from complex ores at Tiger Pinal County, by Mammoth-St. Anthony, Ltd., a low-grade gold mine that yields values in silver, lead, molybdenum, and vanadium, in addition to gold. The vanadium-ore minerals are vanadinite and descloizite. The vanadium and molybdenum are shipped as a Na_2MoO_4–$Na_2V_2O_4$ salt. Operations have been described by Huttl.[24]

Colorado and Utah.—The principal vanadium-ore district in the United States lies in southwestern Colorado and southeastern Utah. The vanadium resources are large, but the individual ore bodies are widely scattered and generally small. Facilities for treating the ores are being expanded in this region, and mining is being carried on at increased rates to meet the present demand for vanadium. Production in Colorado and Utah in 1941, in terms of vanadium contained in vanadium and uranium (carnotite) ores shipped from mines to treatment plants and domestic consumers, amounted to 2,287,718 pounds.

The United States Vanadium Corporation operated its 240-ton mill and a plant to treat tailings at Uravan, Colo. The company also worked on the construction of a new mill at Rifle, Colo., where vanadium operations were carried on from 1925 to 1932. The new plant has a capacity of 200 tons; the first unit—a 100-ton roaster—went into operation in February and the second in April 1942.

The Vanadium Corporation of America treated ore at its Naturita (Colo.) plant during 1941; the mill, reopened in 1940, has a capacity of about 50 tons and handles ore from company property in Montrose and San Miguel Counties, Colo., as well as custom ore. Through a lease agreement with the Defense Plant Corporation, the company will erect a 120-ton plant at Monticello, Utah. The cost of the plant—\$875,000—is being provided by the Defense Plant Corporation, which retains title to the facilities. Operation is scheduled to begin about

[24] Huttl, John B., Mammoth-St. Anthony's Complex Operations Eng. and Min. Jour., vol. 142, No. 12, December 1941, pp. 42–45.

July 1, 1942. In preparation for this new activity, the company maintained during 1941 an ore sampler at Monticello, where ore was purchased and stock-piled.

North Continent Mines, Inc., continued to operate its mill at Slick Rock near Cedar, San Miguel County, Colo. At Gateway, Mesa County, Colo., the Nisley & Wilson Vanadium Mill produced vanadium oxide from custom ores. Gateway Alloys, Inc., formerly treating ore at Gateway, restricted its activity to mining. The Blanding Mines Co. produced ore and oxide from its mine and mill at Blanding, San Juan County, Utah.

Idaho.—The Anaconda Copper Mining Co. recovered vanadium as a byproduct in the treatment of phosphates for fertilizer. The phosphate rock is mined at Conda, Idaho, and treated in reduction works at Anaconda, Mont.

FOREIGN TRADE

Imports of vanadium ores in 1941, virtually all from Peru, totaled 12,323 short tons with a vanadium content of 2,138,608 pounds. Data on exports of vanadium ore and concentrates were not available before 1941. The total exports during 1941 were 28 short tons containing 25,462 pounds of vanadium; details by countries of destination are shown in the following table.

Vanadium ore and concentrates exported from the United States in 1941, by countries

Country	Gross weight (pounds)	Vanadium content (pounds)	Value
Canada	37,150	17,578	$35,603
Japan	7,470	3,552	9,879
Netherlands Indies	629	256	531
United Kingdom	10,422	4,076	17,200
	55,671	25,462	63,213

USES

The principal use of vanadium is in the manufacture of high-speed and low-alloy tool steels and high-strength cast iron and steel forgings. The present demand for vanadium is reflected in the increased use of vanadium-bearing steels, which have been substituted for steels containing nickel and tungsten.

The role of vanadium in forging spring and cast steels has been discussed by Dawe,[25] who states that—

Vanadium as an alloying element in steel has, in recent years, experienced a rapidly increasing number and range of applications. Small percentages have been found to contribute a variety of valuable properties—from toughness, uniformity, and carburizing qualities in the smallest forgings and springs to higher impact resistance, reduction of internal defects, and increased strength in the largest forgings and castings. In addition, a number of other effects generally accompanies the presence of a small amount of vanadium. These include improved machinability, simpler heat treatment, reduced distortion, exceptional weldability, increased wear resistance, better control and uniformity of hardness penetration and gradient, smoother finish, and reduced flaking or spalling of carburized surfaces.

[25] Dawe, C. N., How Vanadium Influences Design Materials. Machine Design, vol 13, No. 10, October 1941, pp. 49–53, 110, 112.

Of interest at this time is the use of chrome-vanadium steels in making propeller hubs, gears, and welded propeller blades for aircraft. Light armor plate for planes and tanks is also made of vanadium steels.

In minor amounts, vanadium is utilized in the ceramic, glass, color, and nonferrous industries and as a catalyst in the manufacture of sulfuric acid.

Vanadium is made available to the steel industry in the form of ferrovanadium, which contains 35 to 40 percent of the element. It is also prepared for commercial use as vanadium oxide and ammonium metavanadate. Fused oxide is used to a minor degree in basic electric-furnace steels, but, in general, the oxide is produced for use in the minor applications mentioned above.

WORLD PRODUCTION

World output of vanadium in ore and concentrates in 1941 was similar in volume to that in 1940. The United States increased its production by 11 percent and assumed the leading position, displacing Peru which ranked second. The Minasragra property of the Vanadium Corporation of America, on the east side of the main Cordillera of the Andes at an elevation of 15,472 feet, produces most of Peru's vanadium output.[26] Part of the ore is treated at a concentrator near the mine. The concentrates average about 25 percent V_2O_5. Sorted ores are also shipped, and in the last 5 years the V_2O_5 content of these ores exported has ranged from about 7 to 15 percent. Vanadium-bearing asphaltites, chiefly in deposits of the Compania Minera Santa Clara y Llacsacocha at Yaulí, Department of Junin, are mined on a small scale.[27] The vanadium is concentrated in the ashes, which are obtained by burning the asphaltite. The company was preparing to mine vanadiferous coal for its vanadium content.

Production of vanadium in South-West Africa in 1941 came entirely from the Abenab and Baltika mines of the Southwest Africa Co., Ltd. Mottramite and descloizite, the vanadium-ore minerals, are found in clay pockets in dolomite. The concentrates average 19.75 percent V_2O_5. The Otavi Minen und Eisenbahn Gesellschaft of Tsumeb, which formerly supplied about half the output of the country, suspended operations in September 1940. The Union of South Africa Government was said to be planning to operate the Otavi company mines.

In U. S. S. R., plans were announced for exploiting titaniferous iron deposits (from which vanadium was also to be recovered) near Lake Onega in the Soviet Karelian-Finnish Republic. A plant was to be built at Pudozhgora to produce high-grade pig iron and ferrovanadium.

It is assumed that Germany and Italy continued to obtain vanadium from the same sources that were known in 1940. Vanadium G. m. b. H., a national cartel, was then reported to be responsible for furnishing the German requirements. Converter slag is the source of the vanadium. Italy recovers vanadium from naphtha soot collected from smokestacks of ships and industrial plants.

[26] Vanderburg, W. O., Vanadium-Peru: Bureau of Mines Mineral Trade Notes, vol. 14, No. 3, March 20, 1942, pp. 16-17.
[27] Vanderburg, W. O., Vanadium-Peru: Bureau of Mines Mineral Trade Notes, vol. 14, No. 4, April 20, 1942, p. 13.

World production of vanadium in ores and concentrates, 1937–41, in metric tons

[Compiled by B B. Waldbauer]

Country	1937	1938	1939	1940	1941
Argentina			15	[1] 4	[1] 7
Mexico	45	180	148	57	(2)
Northern Rhodesia	235	374	384	(3)	(3)
Peru	583	826	996	1,214	1,017
South-West Africa	591	557	514	428	269
United States (shipments)	493	732	900	[4] 981	1,086

[1] Exports.
[2] Less than 1 ton.
[3] Data not available.
[4] Revised figure.

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STEEL. Finds Molybdenum Good Substitute to Relieve Tightness in Vanadium. Vol. 109, No. 17, October 27, 1941, p. 86.

SWARUP, D., AND IYER, V. G. An Investigation Into the Wet Concentration of the Vanadium Occurring in the Iron Ores of Mayurbhanj. Trans. Min., Geol. and Met. Inst. India, vol. 37, August 1941, pp. 45-50.

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TUNGSTEN

By H. W. Davis

SUMMARY OUTLINE

SUMMARY

Consumption of tungsten concentrates in the United States reached an all-time high in 1941; as a consequence, both imports and domestic production established new records. Shipments of tungsten concentrates and high-grade sorted ore from domestic mines were 6,567 short tons (60 percent WO_3 basis), an increase of 23 percent over 1940 and 7 percent greater than in the previous record year 1917. Production in California, Idaho, and Nevada gained substantially in 1941; and the Yellow Pine mine in Idaho made its initial output and shipments in that year. Many new mills were completed during the year; especially noteworthy was the 1,300-ton-daily-capacity concentrating and chemical plant near Bishop, Calif., which began operating in the latter part of 1941. Additions to capacity were made at many existing mills.

Receipts of imported ore and concentrates during 1941 were 13,820 short tons (60 percent WO_3 basis), of which China supplied 68 percent and Latin American countries 25 percent.

Salient statistics of tungsten ore and concentrates in the United States, 1940–41

	1940		1941	
	Short tons, 60 percent WO_3	Value	Short tons, 60 percent WO_3	Value
Domestic production	5,120	(1)	6,748	(1)
Shipments from domestic mines	5,319	$6,576,318	6,567	$9,223,726
Imports:				
General (receipts)	10,157	(1)	13,820	(1)
For consumption	5,896	4,690,723	12,107	11,231,313
Stocks in bonded warehouses, Dec. 31	4,615	3,956,825	6,300	5,740,789

[1] Figures not available.

The Government program to buy tungsten ore for stock-piling and for resale to industry made substantial progress in 1941. Release to industry of part of the Government-held stock pile relieved a temporary stringency in the spot supply in the early part of 1941, which

developed as a result of the closing of the Burma Road from July 18 to October 17, 1940, cutting off tungsten supplies ordinarily supplied by China. The Metals Reserve Co. entered into a contract with Bolivian producers, guaranteed by the Bolivian Government, to purchase their entire production for 3 years at $21 per short-ton unit. An arrangement was also completed with the Argentine Government and producers to purchase up to 3,000 tons of tungsten concentrates for 3 years at $21 per short-ton unit. An agreement was also made to buy, at the market price at the time of purchase, any surplus Mexican tungsten not sold to private industry in the Western Hemisphere. Contracts have been made with three of the largest domestic producers of tungsten to permit substantial increases in output, and similar contracts are being arranged with numerous other producers. A re-treatment plant will be erected in Utah in 1942 to utilize large tonnages of low-grade concentrates, much of which has hitherto not been recovered. Arrangements are also being made for direct purchase of output from small producers. Under the stimulation of a price of $24 per short-ton unit and with the anticipated addition to output from re-treatment of low-grade concentrates, it is expected that domestic production will increase substantially by the end of 1942.

GOVERNMENT EXPLORATION

The Bureau of Mines continued its search for ore deposits of strategic metals, as authorized under section 7 of the Strategic Materials Act. Productive operation in the Yellow Pine district, Idaho, was begun in August over the deposit revealed in the course of diamond drilling by the Bureau of Mines in cooperation with the Geological Survey. This deposit appears to be one of the few outstanding new discoveries of tungsten ore in the United States since 1900. A large number of preliminary examinations of tungsten deposits were completed by the Strategic Minerals Examination Section of the Bureau's Mining Division. Trenching and diamond drilling were completed at Mill City, Nev.; near Bishop, Calif.; and in the vicinity of Shoshone, Nev., and the Huachuca Mountains, Ariz. Although no other large ore bodies were discovered, some ore was found in each instance, which enabled the operating companies either to increase or maintain production at properties where depletion of ore reserves would otherwise have forced reduction of output. At the Ima mine in Lemhi County, Idaho, important new discoveries were made by trenching and diamond drilling; their significance will be determined by further diamond drilling now in progress. It now appears that the new discoveries will bring about a considerable increase in the production rate.

As part of its program of investigation of strategic mineral deposits, the Geological Survey published reports describing tungsten deposits in the Sierra Nevada near Bishop, Calif., and in the Blue Wing district, Lemhi County, Idaho. The tungsten deposits in Mohave County, Ariz., including those in the Boriana mine, were mapped. Detailed mapping of the Tempiute district, Lincoln County, Nev., the tungsten deposits in Beaver County, Utah, and the Deer Park district, Stevens County, Wash., was undertaken. In California the tungsten deposits in the Darwin district, Inyo County, and the Greenhorn Mountain region in Kern and Tulare Counties were examined in considerable detail. In the Nederland district, Boulder County, Colo., the Yellow

Pine district, Valley County, Idaho, and the Seven Devils district, Adams County, Idaho, earlier examinations were continued or extended. A number of smaller districts were visited briefly.

PRICES

Quotations on tungsten ore and concentrates were relatively stable throughout 1941; imported and domestic ores fluctuated only \$2 and \$4 per unit, respectively. However, whereas the price trend of imported ore was downward, that of domestic ore was the reverse. Chinese ore was quoted in the Engineering and Mining Journal at \$26 per short-ton unit of WO_3, duty paid, at the beginning of 1941, was lowered to about \$24 in late January, advanced to \$24.50 in August, but again was reduced to \$24 in late October. Bolivian and Portuguese ores were quoted within the same range as Chinese ore. Domestic scheelite, in carlots, delivered, was quoted at \$23 to \$25 per short-ton unit during the first 9 months of 1941, at \$24 to \$27 in October, and at \$26 to \$27 during the remaining 2 months. The average price for the 1941 shipments, as reported to the Bureau of Mines, was \$23.41 per short-ton unit of WO_3.

DOMESTIC PRODUCTION

Stimulated by greater defense activities, production of tungsten concentrates and high-grade sorted ore in the United States increased 32 percent over 1940 to an all-time high of 6,746 short tons (reduced to an equivalent of 60 percent WO_3) in 1941. Production was obtained from a rather large number of widely scattered operations in Alaska, Arizona, California, Colorado, Idaho, Missouri, Montana, Nevada, New Mexico, South Dakota, Utah, and Washington. California, which displaced Nevada as the principal producing State in 1940, maintained its rank in 1941. Idaho attained the rank of third-largest producing State in 1941, as a result of production at the Yellow Pine mine, where the presence of tungsten was discovered in the spring of 1941.

Tungsten ore and concentrates produced and shipped in the United States, 1940–41, by States

State	Produced				Shipped from mines			
	1940		1941		1940		1941	
	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units
Alaska			26	1,590				
Arizona	348	20,903	280	16,793	349	20,938	277	16,602
California	1,935	116,087	2,704	162,229	2,070	124,213	2,603	156,203
Colorado	657	39,411	646	38,740	693	41,561	631	37,839
Idaho	242	14,524	663	39,781	260	15,580	656	39,381
Missouri	13	760	3	164	13	760	3	164
Montana	50	2,998	7	415	50	2,998	7	415
Nevada	1,788	107,300	2,316	138,983	1,796	107,797	2,289	137,321
New Mexico	(1)	2	3	170	(1)	2	3	170
South Dakota								
Utah	15	899	30	1,802	14	832	30	1,806
Washington	72	4,286	68	4,103	74	4,479	68	4,103
	5,120	307,170	6,746	404,770	5,319	319,160	6,567	394,004

[1] 98 pounds.

Tungsten ore and concentrates shipped from mines in the United States, 1937–41

Year	Quantity		Reported value f. o. b. mines		
	Ore and concentrates, 60 percent WO_3 (short tons)	Tungsten content (pounds)	Total	Average per unit of WO_3	Average per pound of tungsten
1937	3,500	3,331,020	$4,094,000	$19.50	$1.23
1938	3,044	2,897,036	3,161,498	17.31	1.09
1939	4,287	4,080,024	4,402,182	17.11	1.08
1940	5,319	5,062,199	6,576,318	20.61	1.30
1941	6,567	6,249,945	9,223,726	23.41	1.48

Alaska.—At the Riverside mine near Hyder, 30 short tons of tungsten concentrates averaging about 53 percent WO_3 were produced (but not shipped) in 1941. About 700 feet of drifting, raising, and crosscutting from old workings were done during 1940 and 1941. According to J. H. Scott, owner and operator of the mine, metallurgical difficulties in the mill were numerous but are believed to have been solved. It is planned to install considerable additional equipment in the mill in 1942.

Arizona.—Shipments of tungsten concentrates from Arizona operations totaled 246 short tons averaging 67.49 percent WO_3 in 1941 compared with 302 tons averaging 69.33 percent WO_3 in 1940. The output comprised scheelite, wolframite, huebnerite, and ferberite. By far the largest output came from the Boriana mine near Yucca, Mohave County, where wolframite and scheelite concentrates averaging about 70 percent WO_3 were recovered from milling a 1.35-percent WO_3 ore. The mining and milling operations at the Boriana mine have been described in the Mining World.[1] The remainder of the output, which was produced at a number of widely scattered operations, came chiefly from the Tungsten Reef mines in Cochise County; the Gold Crown, Chloriding, and Diff claims and the Williams mine in Mohave County; and the Morning Star claim in Pinal County. At the Williams mine, where the Continental Mining Corporation did extensive development and installed mining and milling equipment and a power plant, operations were discontinued because of unsatisfactory results, mainly high operating costs. The tungsten deposits of Arizona have been described recently by Wilson.[2]

California.—California maintained its rank as the principal tungsten-producing State in 1941. Shipments of tungsten concentrates (virtually all scheelite) from California totaled 2,629 short tons averaging 59.42 percent WO_3 in 1941 compared with 2,076 tons averaging 59.83 percent WO_3 in 1940. Although tungsten concentrates were shipped from a large number of widely scattered operations, four producers—Atolia Mining Co. (in San Bernardino County) and United States Vanadium Corporation, Tungstar Corporation, and West Coast Tungsten Co. (all in Inyo County)—accounted for 2,263 tons, or 86 percent of the State total. The bulk of the remainder was shipped from the Black Rock mine in Mono County; Schober, Tung-

[1] Mining World, Boriana Tungsten Operations in Arizona of the Molybdenum Corporation: Vol. 3, No. 3, March 1941, pp. 9–15.

[2] Wilson, E. D., Tungsten Deposits of Arizona: Arizona Bureau of Mines Geol. Ser. 14, Bull. 148, vol. 12, No. 2, 1941, 54 pp.

sten City, and Tungsten Blue mines in Inyo County; Woody, Tungsten Chief, and Sierra Tungsten mines in Kern County; Tungstore mine in Tulare County; and Garnet Dike mine in Fresno County.

Production of tungsten concentrates in California was 2,747 short tons averaging 59 percent WO_3 in 1941 compared with 1,935 tons averaging 60 percent WO_3 in 1940. Of the 1941 total, Inyo County supplied 65.7 percent, San Bernardino 24.8 percent, Mono 3.3 percent, Kern 2.6 percent, Tulare 1.5 percent, Fresno 1.3 percent, and Madera and undistributed 0.8 percent. The largest producer in California during 1941 was the United States Vanadium Corporation, which operated the Pine Creek mine near Bishop and, in addition, milled ore and tailings from other properties in California and Nevada. The concentrates recovered from milling ore and tailings from Nevada have been credited to that State in the statistics. The new concentrating and chemical treatment plant of the company was completed and put into operation the latter part of 1941. The daily capacity of the plant is 1,300 tons of tungsten-molybdenum ore. The process that has been developed to treat the complex Pine Creek ore is the result of 4 years of research and development. The new plant will replace the present 450-ton plant at the mine portal, at an elevation of 10,700 feet, and is situated at the junction of Pine and Morgan Creeks, 2 miles distant and 3,000 feet lower than the present mill. The original chemical plant first used in conjunction with the upper mill is being used as a custom plant to treat low-grade flotation concentrates from various mines. Residues as low as 2.75 percent WO_3 are being successfully treated in this plant, and the operator has been cooperating with other mills to make available the process developed at Pine Creek to produce additional tungsten to meet demands of the war program. The new concentrating and chemical treatment plant has been described by Burwell.[3]

A recent report[4] describes the tungsten deposits adjacent to Pine Creek and near the crest of the Sierra Nevada. It also includes brief summary descriptions of other prospects in extensions of the same narrow belt and of mines and prospects southwest of Bishop.

The mining and milling of tungsten at the Tungstar mine have been described by Lenhart[5] and Hamilton.[6]

The tungsten mines and deposits of California have been described by Partridge.[7]

Colorado.—Production of tungsten concentrates in Colorado was 810 short tons averaging 48 percent WO_3 in 1941, or virtually the same as in 1940. Shipments, however, declined slightly to 787 tons averaging 48 percent WO_3 in 1941 from 849 tons averaging 49 percent WO_3 in 1940. Virtually all the output was ferberite from Boulder County, the greater part of which came from operations of the Wolf Tongue Mining Co. and the Vanadium Corporation of America. A comparatively small quantity of huebnerite was produced in San Juan County in 1941.

[3] Burwell, Blair, Milling Tungsten Ores at Pine Creek: Min Cong. Jour., vol. 27, No. 10, October 1941, pp 16–18.
[4] Lemmon, D. M., Tungsten Deposits in the Sierra Nevada near Bishop, Calif.: Geol. Survey Bull. 931–E, 1941, pp. 79–104.
[5] Lenhart, W. B., Milling Scheelite at Tungstar Mine: Min. Cong. Jour., vol. 27, No. 4, April 1941, pp. 67–71.
[6] Hamilton, Richard, Tungstar's Recovery of Scheelite: Min. Jour. (Phoenix, Ariz.), vol. 25, No. 18, February 15, 1942, p. 6.
[7] Partridge, J. F., Jr., Tungsten Resources of California: California Jour. Mines and Geol., vol. 37, No. 2, April 1941, pp. 225–326.

Idaho.—Production of tungsten concentrates in Idaho was 1,291 short tons averaging 30.81 percent WO_3 in 1941 compared with 224 tons averaging 64.84 percent WO_3 in 1940. Shipments were 1,269 tons averaging 31.03 percent WO_3 in 1941 compared with 240 tons averaging 65 percent in 1940.

The Ima mine in the Blue Wing district, Lemhi County, was inactive because of labor difficulties from August 1 to October 27, 1941. The mine power plant was destroyed by fire in January 1941. Chiefly as a consequence of these interruptions, production of huebnerite concentrates at the Ima mine declined to 180 tons in 1941 from 224 tons in 1940; the concentrates average about 65 percent WO_3.

At the Miller property, also in the Blue Wing district, the General Electric Co. has undertaken an extensive development program involving 3,000 to 4,000 feet of diamond drilling, trenching with a caterpillar tractor on some bedding veins, and a crosscut drift that has progressed nearly 2,000 feet. Not enough ore has been uncovered, however, to justify any milling operations.

The geology, ore deposits, and mines and prospects in the Blue Wing district, Lemhi County, have been described by Callaghan and Lemmon.[8]

The chief producing mine in Idaho is the Yellow Pine near Stibnite in Valley County, where tungsten production was begun in August 1941; during the remainder of 1941, 14,498 short tons of ore averaging 2.4 percent WO_3 were produced and treated, yielding 1,111 short tons of concentrates averaging 25.45 percent WO_3. The presence of tungsten at the Yellow Pine mine was discovered jointly by engineers of the Bureau of Mines and geologists of the Geological Survey in the spring of 1941. The Yellow Pine mine has been described in considerable detail by Bradley.[9]

Missouri.—A small quantity (3 short tons averaging 55.07 percent WO_3) of huebnerite was shipped from the Silver mine near Fredericktown, Madison County, in 1941. In 1940 shipments were 12 short tons averaging 65.13 percent WO_3.

Montana.—Production of scheelite concentrates in Montana was 8 short tons averaging 51.88 percent WO_3 in 1941 compared with 42 tons averaging 70.62 percent WO_3 in 1940. Of the 1941 total, 7 tons averaging 56.56 percent WO_3 were produced as a byproduct of gold at the Jardine mine in Park County, and 1 ton averaging 48.5 percent WO_3 came from the New Deal Placer property near Philipsburg, Granite County.

Nevada.—Nevada was the second-largest tungsten-producing State in 1941. Production and shipments of concentrates (reduced to an equivalent of 60 percent WO_3) were 2,316 and 2,289 short tons, respectively, in 1941 compared with 1,788 and 1,796 tons, respectively, in 1940. The greater part of the production was scheelite concentrates from operations of the Nevada-Massachusetts Co. and affiliated companies, which operate mills at Mill City, Golconda, and Oreana. The Nevada-Massachusetts Co. completed and put into production at Mill City a flotation plant to treat tailings from previous milling operations and the Golconda Syndicate at Golconda a chemi-

[8] Callaghan, Eugene, and Lemmon, D. M., Tungsten Resources of the Blue Wing District, Lemhi County, Idaho: Geol. Survey Bull. 931-A, 1941, pp. 1-21.
[9] Bradley, J. D., The Yellow Pine Mine—A Gold, Silver, Antimony, and Tungsten Producer in Central Idaho: Min. Cong. Jour., vol. 27, No. 9, September 1941, pp. 16-21.

cal plant to treat tungsten-bearing psilomelane. Smaller but important producers in 1941 were Nevada Scheelite, Inc., operating the Leonard mine in Mineral County; Tungsten Metals Corporation, operating the Scheelite Chief, Oriole, Everitt, and Silver Bell mines in White Pine County; and Lincoln Mines, Inc., operating the Tem-Piute mine in Lincoln County. At the Leonard mine the shaft was extended 150 feet, a station was cut on the 200-foot level, and 400 feet of drifting were done. Of the other smaller producing mines in 1941, the largest were the Tungsten Minerals, Hill Top, and Cherry Creek in White Pine County; Ajax and Gun Metal in Mineral County; Contact Group in Pershing County; Comet in Lincoln County; and Star in Elko County.

New Mexico.—Small quantities (50 units) of tungsten concentrates were produced at two localities in New Mexico in 1941—near Gage, Luna County, and White Oaks, Lincoln County.

South Dakota.—A small quantity of ore containing ferberite and scheelite was produced at the Mineral Ridge property near Hill City, Pennington County.

Utah.—Shipments from Utah were 44 short tons of scheelite averaging about 41 percent WO_3 in 1941 compared with 14 tons averaging 59.43 percent WO_3 in 1940. Although production came from operations in Beaver, Box Elder, Juab, Millard, and Tooele Counties, about three-fourths was from the Estelle mine in Tooele County and the Lone Pine mine in Box Elder. Mills were installed in Juab County near Delta by the Apex Tungsten Mining & Milling Co.; near Lucin, Box Elder County, by Massae Tungsten Mining Corporation; and near Milford, Beaver County, by the Prosper Mining Co. The tungsten ore body at the Prosper Mining Co. was discovered in October 1940, and in January 1941 part of it was leased to the Nevada-Massachusetts Co., which did considerable development work. In December 1941 the entire ore body and mill were leased to the Nevada-Massachusetts Co., which plans to remodel and greatly enlarge the mill. According to an announcement (March 26, 1942) of the Metals Reserve Co., "a re-treatment plant will be erected in Utah which will permit the utilization of large tonnages of low-grade concentrates, much of which has hitherto not been recovered. Arrangements are being made for direct purchase of production from small producers."

Washington.—Shipments of tungsten concentrates from Washington were 121 short tons averaging 33.91 percent WO_3 in 1941 compared with 92 tons averaging 48.68 percent WO_3 in 1940. The bulk of the production came from the Germania mine near Fruitland, Stevens County, where the General Electric Co. worked over surface float and tailings to recover 32 short tons of wolframite concentrates averaging 65 percent WO_3 and 75 tons of wolframite jig concentrates averaging 14 percent WO_3; no new development was undertaken at the property during 1941. Comparatively small quantities of wolframite concentrates were produced by James Keeth and the Industrial Tungsten Corporation from properties near Fruitland, Stevens County.

FOREIGN TRADE [10]

Domestic supplies of tungsten are inadequate for requirements, and the United States imports both tungsten concentrates and products,

[10] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

chiefly the former. Receipts of imported ore and concentrates (tungsten content) during 1941 totaled 13,152,716 pounds—a new record. Bolivia and China supplied 18 and 68 percent, respectively, of the 1941 total.

Imports for consumption amounted to 11,522,190 pounds (tungsten content) during 1941, and Bolivia and China supplied 25 and 57 percent, respectively. In addition, 27,558 pounds of tungsten in concentrates were imported from Bolivia for smelting, refining, and export during 1941. Material brought in for smelting, refining, and export is free of duty. There is no record of any exports of tungsten ore and concentrates from the United States.

Tungsten ore and concentrates imported into the United States in 1941, by countries

Country	General imports [1]		Imports for consumption [2]		
	Gross weight (pounds)	Tungsten content (pounds)	Gross weight (pounds)	Tungsten content (pounds)	Value
Africa:					
Union of South Africa	520,140	278,241	230,954	124,343	$136,400
Other British South Africa	73,722	39,466	70,227	37,579	40,451
Argentina	835,606	443,485	976,032	515,729	487,869
Australia	70,600	39,427	180,458	97,874	80,681
Belgian Congo	121,852	70,546	87,276	41,826	56,583
Bolivia	5,725,854	2,324,172	7,087,521	2,895,568	2,752,843
Brazil	737	384	737	384	225
British Malaya	58,335	30,723	59,179	31,619	23,044
Chile	55,793	25,112			
China	17,177,846	9,010,519	12,803,295	6,575,020	6,584,040
French Indochina	24,992	14,237	24,992	14,237	12,901
Mexico	169,905	78,318	174,000	79,801	79,592
Peru	704,313	359,273	669,566	326,333	290,612
Portugal	714,235	354,576	711,749	371,632	307,728
Thailand	141,778	78,237	774,025	410,245	378,344
Total: 1941	26,395,708	13,152,716	[3] 23,850,011	[3] 11,522,190	[3] 11,231,313
1940	18,481,342	9,666,228	[3] 10,829,093	[3] 5,610,882	[3] 4,690,723

[1] Comprises ore and concentrates received in the United States; part went into consumption during year and remainder entered bonded warehouses.
[2] Comprises ore and concentrates withdrawn from bonded warehouses during year (irrespective of time of importation) and receipts during year for consumption
[3] In addition, following quantities were imported for smelting, refining, and export—1941: 48,196 pounds containing 27,558 pounds of tungsten and valued at $21,1[illegible] , 1940 2,546,166 pounds containing 1,348,495 pounds of tungsten and valued at $1,023,426.

Imports of tungsten metal were 36,793 pounds (tungsten content) valued at $48,307 in 1941; all came from the United Kingdom. No tungsten carbide, tungstic acid and other compounds of tungsten, or combination containing tungsten or tungsten carbide was imported in 1941.

Exports of tungsten metal, wire, shapes, and alloys other than ferrotungsten (for which export data are not available) were 195,762 pounds in 1941 compared with 237,940 pounds in 1940.

USES

Of the tungsten ore and concentrates consumed in the United States during 1941, about 75 percent was converted to ferrotungsten and metallic tungsten, 20 percent was added directly to furnaces in the manufacture of alloy steel, and 5 percent was used in various tungsten chemicals.

The chief use of tungsten, according to quantity, is in the manufacture of cutting tools, the majority of which are made of high-speed steel containing about 18 percent tungsten, 4 percent chromium, and 1 percent vanadium—commonly known as "18–4–1." Smaller quantities of tungsten are used in numerous other types of high-speed steels. Other important uses of tungsten are in stellite and tungsten carbide cutting tools, magnet steels, austenitic valve steels and valve seats, armor-piercing projectiles, and erosion-resisting gun liners. Minor amounts of tungsten are used in lamp and radio-tube filaments, X-ray targets, and electrical contact points. Tungsten salts are used in the chemical, pigment, and tanning industries.

To conserve the supply of tungsten, molybdenum-tungsten high-speed steels (which contain 1 to 2 percent tungsten and 5 to 10 percent molybdenum) and sintered carbide materials (part of which are of the tungsten type) are being used successfully for many applications of tungsten high-speed steels; and molybdenum-manganese steel is being used for bullet cores.

WORLD PRODUCTION

Because of Government restrictions on the publication of statistics for many countries, few figures for 1940 and 1941 are available.

Argentina.—Argentina ranks second to Bolivia as a producer of tungsten in South America. All the tungsten produced is exported, and shipments abroad have increased phenomenally during the past decade. Exports in 1941 amounted to 1,897 short tons, of which 1,112 tons were shipped to the United States and 718 tons to Japan; 67 tons were destined to Germany in July, but the ship was intercepted by the British. Exports in 1940 were 1,585 short tons, of which 1,271 tons were shipped to the United States, 308 tons to Japan, and 6 tons to Sweden. Exports to Japan ceased after September 1941.

Bolivia.—Bolivia is the largest tungsten producer in South America. The first production recorded was in 1905, and the annual output through 1913 averaged less than 300 tons. During the World War of 1914–18, production averaged 2,471 metric tons (60 percent WO_3 basis) annually and attained a peak of 4,215 tons in 1917. From 1919 through 1934, annual production dropped to an average of about 500 tons, then increased progressively from 1,423 tons in 1935 to 4,353 tons in 1941. Of the total production in 1941, the Banco Minero de Bolivia (representative of the small miners) exported 1,625 tons, Cie. Aramayo de Mines en Bolivie 1,067 tons, International Mining Co. 760 tons, Bolivian Tin & Tungsten Mines 318 tons, and several small producers 583 tons.

Burma.—Burma ranks second to China as a producer of tungsten. Recent production figures are not available, but 9,025 metric tons (60 percent WO_3 basis) were produced in 1939 compared with 7,796 tons in 1938.

Canada.—Tungsten occurs in many parts of Canada in association with gold ores, and during 1941 shipments of tungsten ores were made to the Department of Mines for treatment. A small plant for the recovery of scheelite is being erected at the Hollinger mine at Timmins, Ontario.

China.—Production figures for China, principal producing country, are not available for 1941, but 9,474 short tons (60 percent WO_3 basis) were received in the United States.

World production of tungsten ores, 1937–41, by countries, in metric tons of concentrates containing 60 percent WO_3 [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
North America:					
Mexico	33	76	118	112	99
United States (shipments)	3,175	2,761	3,889	4,825	5,957
	3,208	2,837	4,007	4,937	6,056
South America:					
Argentina	866	1,195	1,309	1,417	1,745
Bolivia (exports)	1,802	2,530	3,337	4,183	4,853
Brazil (exports)	6	2	7	9	29
Chile	5	5	(2)	(2)	(2)
Peru	78	170	170	290	337
	2,757	3,902	(2)	(2)	(2)
Europe:					
France	...	22	(2)	(2)	(2)
Great Britain: Cornwall	148	258	(2)	(2)	(2)
Italy	3	4	(2)	(2)	(2)
Norway	3	19	31	(2)	(2)
Portugal	2,069	2,810	3,851	4,858	(2)
Spain	250	215	(2)	299	504
Sweden	127	180	200	(2)	(2)
	2,600	3,508	(2)	(2)	(2)
Asia:					
Burma	7,393	7,796	9,025	(2)	(2)
China (exports)	17,895	13,387	11,580	3,118	(2)
Chosen	2,058	(2)	(2)	(2)	(2)
India, British	15	12	(2)	(2)	(2)
Indochina: Tonkin	648	545	510	392	(2)
Malay States:					
Federated Malay States	1,077	749	246	108	(2)
Unfederated Malay States	279	333	362	427	(2)
Netherlands Indies	(3)	(3)	2	(2)	(2)
Thailand	221	251	378	400	(2)
	29,586	(2)	(2)	(2)	(2)
Africa:					
Egypt	193	(2)	...	15	(2)
Morocco, French	...	7	(2)	(2)	(2)
Nigeria	9	49	237	131	(2)
Southern Rhodesia	275	329	270	(2)	(2)
South-West Africa	41	48	50	24	[4] 62
Tanganyika Territory	2	5	(2)	2	(2)
Uganda	2	2	2	(2)	(2)
Union of South Africa	40	127	100	105	[4] 49
	562	(2)	(2)	(2)	(2)
Oceania:					
Australia:					
New South Wales	66	113	(2)	(2)	(2)
Northern Territory	345	515	354	320	(2)
Queensland	110	167	107	(2)	(2)
Tasmania	345	390	472	(2)	(2)
New Zealand	28	54	49	88	(2)
	894	1,239	(2)	(2)	(2)
	39,607	(2)	(2)	(2)	(2)

[1] In addition to countries listed, tungsten ore is produced in Japan, U. S. S. R., and Western Australia, but data on production are not available.
[2] Data not available.
[3] Less than 1 ton.
[4] January to June, inclusive.

Chosen.—According to Emmons:[11]

To coordinate and develop the tungsten production of Chosen, arrangements have been announced to center the control of all the tungsten mines of the peninsula in three principal companies, the Japan Mining Co., Japan High Cycle Heavy Industry Co., and Kobayashi Mining Co. The consumption of all domestic tungsten will be limited to seven principal manufacturing concerns. The Kobayashi Mining Co. is reported to be exploiting several newly developed tungsten deposits and to be constructing an ore sorting mill at Yotoku in South Heian Province. A new tungsten deposit is also being developed by Kongo Special Mining Co. in the Diamond Mountains (Kongo San).

Peru.—The only tungsten deposits of proved economic importance in Peru are in the Provinces of Santiago de Chuco and Pallasca in the Departments of La Libertad and Ancash in the west-central part of Peru. These deposits became important during the 1914–18 war period, when a peak production of 532 metric tons of concentrates was attained in 1916. After hostilities ceased, the operators were unable to compete with other sources of supply, and production declined to low figures. The Peruvian deposits have again become increasingly active, and since 1937 production has advanced from 78 metric tons to 337 tons in 1941.

Spain.—Production of wolframite in Spain was 504 metric tons in 1941 compared with 299 tons in 1940. The greater part (426 tons) of the 1941 production came from the Province of Coruña, the remainder being divided between the Provinces of Badajoz and Salamanca. The wolframite boom led to much prospecting and surface mining of hitherto deserted mines in Badajoz Province, where output in December 1941 was five times that of the total for the other 11 months.

[11] Emmons, A. B., 3d (Am. Vice Consul, Keijo, Chosen), Production of Nonferrous Metals and Secondary Minerals in Chosen in 1941: Ms. Rept., May 29, 1941, p. 4.

BAUXITE AND ALUMINUM

By Herbert A. Franke and M. E. Trought [1]

SUMMARY OUTLINE

SUMMARY

Production (618,134,000 pounds) and consumption (605,577,231 pounds) of primary aluminum in 1941 advanced 50 and 33 percent, respectively, over those in 1940. However, 1941 was only the beginning of a new era for aluminum as the Nation prepared for its greatest war, which could not be won unless vast quantities of the light, strong metal were available to build bombers, pursuit planes, and other implements of modern warfare. To meet this objective the War Production Board has recommended expansion of annual domestic aluminum capacity to approximately 2,100,000,000 pounds and the procurement of metal from Canada at a rate that would reach 450,000,000 pounds in 1943. In 1942 production and consumption of aluminum should substantially exceed 1,000,000,000 pounds; by 1943 production is expected to be about double that, and consumption should approach 2,500,000,000 pounds.

Highlights of the industry in 1941 included the following: Mandatory priorities were placed on aluminum in February; the secondary aluminum industry became completely disorganized early in the year following three successive price reductions on primary metal in 1940; as military requirements rose during the summer virtually all civilian uses for aluminum were stopped; and on October 1 the fourth price reduction within 19 months (by the Aluminum Co. of America) brought the price of primary aluminum from 17 cents to 15 cents a pound. In December the United States was at war with Japan, Germany, and Italy and thankful that the private aluminum expansion program and the first Government one were well on their way. The Aluminum Co. of America increased production capacity at all five of its aluminum reduction plants, notably at Vancouver, Wash.,

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

and the Reynolds Metals Co. became the second substantial domestic producer of aluminum. The Aluminum Co.'s expansion program was completed in March 1942, and in May 1942 three new Government-owned aluminum plants (under the first expansion program) had already started operations.

Recovery of secondary aluminum increased 33 percent in 1941. Imports and exports of crude and semicrude aluminum in 1941 declined 26 and 73 percent, respectively, compared with 1940.

Production (894,174 long tons) and consumption (1,721,475 long tons) of bauxite in 1941 increased 104 and 61 percent, respectively, compared with 1940. As with aluminum production, the large output of bauxite in 1941 will be dwarfed by that of 1942 and 1943. Original plans called for the domestic production of 1,899,000 tons (1,344,000 of low-silica and 555,000 of high-silica ore) and the importation of 1,386,000 tons of bauxite in 1942, and the production of 3,290,000 tons (1,600,000 of low-silica and 1,690,000 of high-silica ore) and the importation of 1,800,000 tons of bauxite in 1943. Enemy submarines began sinking South American bauxite cargoes destined to aluminum plants in the United States and Canada in the spring of 1942, which probably will necessitate an "all-out" domestic mining program and greatly increase the bauxite-production goals set above (possibly to 6,000,000 tons or more) for Arkansas and other Southern States. Owing to the shipping crisis, an allocation order was issued July 7, 1942, effective August 1, 1942, to conserve and direct the distribution of bauxite and alumina. It is estimated that domestic consumption of bauxite will reach about 2,600,000 tons in 1942 and 5,100,000 tons or more in 1943.

In 1941 imports of bauxite (1,116,546 long tons, 88 percent of which came from Surinam) exceeded those in 1940 by 77 percent. Exports (dried equivalent) rose 82 percent. Of the domestic and foreign bauxite consumed, the aluminum industry used 69 percent; chemical, 17 percent; abrasive, 12 percent; and other industries, 2 percent. Compared with 1940, the aluminum industry increased its consumption of bauxite approximately 82 percent, and the abrasive and chemical industries each used better than 60 percent more ore. Domestic output was equivalent to 36 percent and imports to 64 percent of the total ore consumed. Shipments from Arkansas mines comprised 91 percent of the total domestic production, and output in Georgia, Alabama, and Virginia rose substantially above that of 1940. Although the minimum quoted price for domestic bauxite advanced 17 percent, the average value actually received for all grades of ore shipped was only slightly above that for 1940.

World production of bauxite is believed to have increased 36 percent and of aluminum 40 percent in 1941. Axis and Allied production of aluminum was "neck and neck" in 1941, but in 1942 and 1943 United Nations output is expected to greatly exceed that of the Axis.

Salient statistics of the bauxite and aluminum industries in the United States, 1939–41

	1939	1940	1941
Bauxite:			
Production (mine shipments) [1] ....long tons..	375,307	438,913	894,174
Value [2]	$2,166,236	$2,578,968	$5,358,976
Imports [2] .... long tons..	520,179	629,552	1,116,546
Exports (including concentrates) [2] ....do....	51,635	81,913	134,746
World production ....do....	4,238,000	[3] 4,620,000	[3] 6,296,000
Aluminum.			
Primary production ....short tons..	163,545	206,280	309,067
Value	$64,600,000	$75,292,000	$100,395,000
Quoted price per pound [4] ....cents..	20 0	18.7	16.5
Secondary production ....short tons..	53,947	80,362	106,857
Imports	$4,766,260	$5,159,924	$3,827,543
Exports	$23,705,250	$22,437,125	$6,872,522
World production ....short tons..	[3] 777,000	[3] 903,000	[3] 1,268,000

[1] Dried-bauxite equivalent. [2] As shipped. [3] Estimated.
[4] New York: 99 percent plus, pure virgin ingot, according to Metal Statistics, 1942, published by American Metal Market.

BAUXITE

PRODUCTION

An all-time record was established in 1941, when production (mine shipments converted to dried basis) of bauxite in the United States increased 104 percent in quantity and 108 percent in value over that of 1940. Production rose 90 percent in Arkansas, 593 percent in Alabama, 653 percent in Georgia, and 739 percent in Virginia.

Mines in Saline and Pulaski Counties, Ark., produced 91 percent of the total domestic output in 1941. American Cyanamid & Chemical Corporation operated the Townsend, Cleveland, Ozark Nos. 24 and 28, Globe, Rauch, and Heckler properties. Large-scale stripping operations were conducted at the Townsend and Ozark No. 24 mines, chiefly during August 1941 when considerable ore was mined and stock-piled. Consolidated Chemical Industries, Inc., abandoned its Gates lease (Alexander No. 2 mine) during the summer and began to develop a new property in Pulaski County. American Cyanamid & Chemical Corporation later acquired the Gates lease. Crouch Mining Co., Inc. (owned by General Abrasives Co.), continued development work underground at its new Young mine in Saline County and completed installing a large, new, rotary calcining kiln in December 1941, which substantially increased its processing capacity. Dixie Bauxite Co., Inc., continued operations at its Dixie No. 2 mine and began underground mining on the Wright property, formerly worked by the Pulaski Bauxite Co. Dulin Bauxite Co., Inc., started to produce early in 1941 on the Reichardt lease several miles south of Little Rock and early in 1942 began to develop the Harley and Thorpe leases and to construct a processing plant at Sweet Home. Republic Mining & Manufacturing Co. (Aluminum Co. of America subsidiary), the principal domestic producer, extended its previous open-pit and underground mining operations and commenced or completed stripping overburden from bauxite on large areas in secs. 14 and 15, T. 2 S., R. 14 W. (including the Alexander Hill deposit). Reynolds Mining Corporation acquired bauxite-mining rights to several properties in Saline and Pulaski Counties and did extensive geological and other exploratory work thereon in 1941.

Bauxite shipped from mines in the United States, 1937-41, by States

State and year	Long tons					Value f. o. b. mine, as shipped
	Crude	Dried	Calcined	Total		
				As shipped	Dried-bauxite equivalent	
Alabama and Georgia						
1937	3,410	14,627		18,037	17,614	$121,825
1938	5,532	[1] 12,542		18,074	17,253	132,882
1939	2,727	11,318		14,045	13,617	91,282
1940	[2] 2,363	9,342		[2] 11,705	[2] 11,381	[2] 77,575
1941	[2] 66,133	23,081		[2] 89,214	[2] 80,205	[2] 406,137
Arkansas:						
1937	98,340	257,023	46,832	402,195	407,462	2,322,861
1938	72,097	194,945	[1] 26,238	293,280	293,663	1,679,663
1939	99,215	225,355	[3] 36,686	361,256	361,690	2,074,954
1940	114,921	261,103	[3] 47,259	423,283	427,532	2,501,393
1941	221,338	532,775	[3] 59,432	813,545	813,969	4,952,839
Total United States:						
1937	101,750	271,650	46,832	420,232	425,076	2,444,686
1938	77,629	[1] 207,487	[1] 26,238	311,354	310,916	1,812,545
1939	101,942	236,673	[3] 36,686	375,301	375,307	2,166,236
1940	117,284	270,445	[3] 47,259	434,988	438,913	2,578,968
1941	287,471	555,856	[3] 59,432	902,759	894,174	5,358,976

[1] Includes small quantity of activated. [2] Includes Virginia. [3] Includes sintered.

Bauxite mining was active in Alabama during 1941. In the Barbour-Henry County area the Bauxite Co. of Alabama and the Barbour Bauxite Co. commenced new operations, and the Republic Co. and Floridin Co. also were active. J. C. Hebble started mining ore in a new field 3 miles south of Ashville in St. Clair County. In Sumter County, Ga., American Cyanamid & Chemical Corporation resumed activities by opening up the Thig Pen mine, and Benjamin Easterlin shipped a small quantity of ore from his property. Early in 1942 the General Ore Co., Inc., started operations near Silver Creek, Floyd County, Ga., and near Eufaula, Barbour County, Ala. In Virginia the Republic Co. shipped ore in 1941 from the Lightner and Allen mines, Augusta County.

Following a general canvass by the Bureau of Mines in March 1941 of current bauxite production, capacity, and proved reserves, the Bureau of Mines and the Geological Survey made a detailed preliminary survey of domestic bauxite resources. Results of this survey were published in November 1941.

Estimated bauxite reserves of the United States [1] in long tons and by grade,[2] and alumina content, in percent

State	Grade and alumina content, percent				
	A (55 plus)	B (50 to 55)	C (45 to 50)	D (30 to 45)	Total
Arkansas	9,090,000	8,443,000	7,803,000	1,918,000	27,254,000
Alabama	16,000	79,000	33,000	230,000	358,000
Georgia	237,000	311,000	481,000		1,029,000
Mississippi		23,000	100,000	200,000	323,000
Tennessee		36,000	22,000		58,000
Virginia		6,000			6,000
Total	9,343,000	8,898,000	8 439,000	2,348,000	29,028,000

[1] Thoenen, J. R., and Burchard, E. F., Bauxite Resources of the United States. Bureau of Mines Rept. of Investigations 3598, 1941, p. 39.
[2] Grades are as follows A = 55 plus percent Al_2O_3, minus 7 percent SiO_2, B = 50 to 55 percent Al_2O_3, 7 to 15 percent SiO_2; C = 45 to 50 percent Al_2O_3, 16 to 30 percent SiO_2, D = 30 to 45 percent Al_2O_3, high in silica and iron.

With the tremendous aluminum-production program planned, known domestic reserves of high-grade bauxite would be exhausted within a few years if dependence were placed solely thereon. In view of this critical situation Congress appropriated funds in the fall of 1941 for a more comprehensive investigation by the Bureau of Mines and Geological Survey of the occurrence, extent, and quality of domestic bauxite, alunite, and high-alumina clay deposits.

Because of the limited reserves of high-grade ore, large quantities of marginal or high-silica bauxite (B and C grades) must be mined in 1942 and 1943, chiefly in Arkansas, for the new Hurricane Creek and Baton Rouge alumina plants. Stripping the overburden with power shovels and Le Tourneau and Euclid wagons and other development work on the low-grade deposits were started in 1941 by the Republic Mining & Manufacturing Co., American Cyanamid & Chemical Corporation, and Reynolds Mining Corporation.

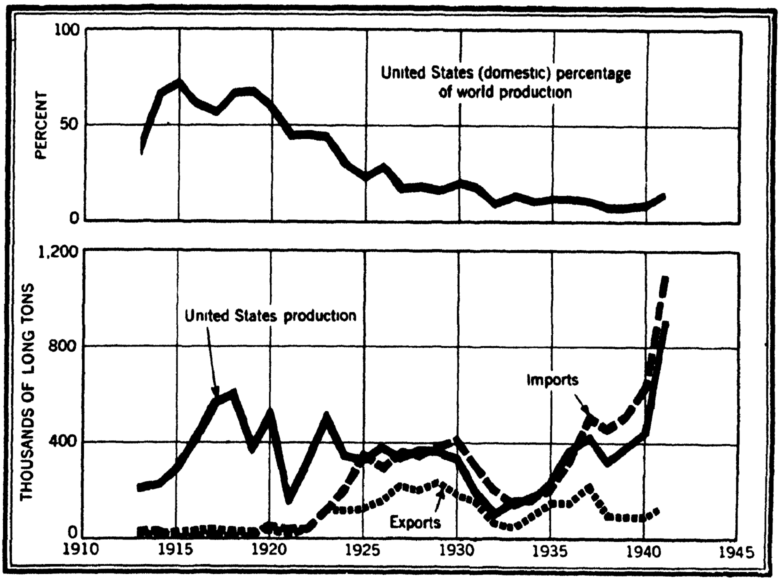

FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913–41.

Stocks of bauxite on hand at mines and processing plants on December 31, 1941, totaled 157,600 long tons (dried-bauxite equivalent) compared with 168,600 tons on December 31, 1940. Stocks at consumers' plants increased from 221,900 tons at the beginning of the year to 541,600 tons at the end of the year.

CONSUMPTION

Actual domestic consumption of bauxite (as determined by special monthly consumer surveys conducted by the Bureau of Mines for Federal war agencies) totaled 1,721,475 tons (dried-bauxite equivalent) in 1941 and compares with an apparent consumption of 1,072,000 tons in 1940. Both quantities include exports to Canada, as virtually all bauxite shipped there during those years was to American-owned abrasive plants for the manufacture of crude abrasives reimported

into the United States for final manufacture and consumption. Consumption of the 1,721,475 tons was as follows: Aluminum industry, 1,190,710 tons; chemical, 295,348; abrasive (including refractories), 210,060; and cement, oil-refining, steel, and ferro-alloy industries, 25,357 tons. Consumption of bauxite "as shipped" totaled 1,642,458 tons and consisted of 1,478,509 tons of dried bauxite, 132,962 tons of calcined, and 30,987 tons of undried and activated ore. Of this bauxite, 64 percent was foreign and 36 percent domestic ore. The aluminum industry used 94 percent and the chemical industry 5 percent of the foreign ore. About 1 percent of the foreign bauxite was employed in abrasives, cements, and other uses.

Apparent domestic consumption, shown in the table below, is presented from two different points of view; and apparent consumption within the United States does not correspond with the data above, inasmuch as the calculations are based upon "shipments" to domestic plants and do not consider fluctuations in consumers' stocks.

Shipments, imports, exports, and apparent consumption of bauxite in the United States, 1937–41, in long tons

[Dried-bauxite equivalent]

Year	Domestic shipments from mines and processing plants to industry			Imports	Exports	Apparent consumption within United States	Apparent consumption, including shipments to Canada for processing [1]
	Arkansas	Alabama and Georgia [2]	Total				
1937	415,050	17,614	432,664	507,423	210,657	729,430	921,000
1938	275,078	17,253	292,331	455,693	90,341	657,683	732,000
1939	335,647	13,689	349,336	520,179	86,540	782,975	867,000
1940	437,595	[2] 11,603	449,198	629,552	120,055	958,695	1,072,000
1941	857,804	[2] 79,812	937,616	1,116,546	218,691	1,835,471	[3] 1,721,475

[1] Includes exports to Canada, inasmuch as virtually all of this bauxite is shipped to American-owned plants in Canada for manufacture into crude abrasives reimported into the United States for final manufacture and consumption.
[2] Includes Virginia in 1940 and 1941.
[3] Actual consumption.

BY INDUSTRIES

Bauxite shipped from mines and processing plants in the United States, 1937–41, by consuming industries, in long tons

Industry	1937		1938		1939		1940		1941	
	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent
Aluminum [2]	209,476	209,476	144,208	144,208	161,008	161,008	215,131	214,194	552,467	533,578
Chemical	78,261	79,150	63,940	63,350	81,444	79,536	82,799	80,933	143,783	141,334
Abrasive [3]	88,685	135,849	48,999	74,614	55,346	82,326	80,823	128,818	132,645	212,482
Oil refining, refractory,[3] and other	7,107	8,189	10,332	10,159	14,238	26,466	12,727	25,253	45,866	50,222
Total quantity	383,529	432,664	267,479	292,331	312,036	349,336	391,480	449,198	874,761	937,616
Total value	$2,722,403		$1,823,307		$2,448,038		$3,075,317		$6,155,714	

[1] Includes crude, dried, and calcined, 1937–41; also activated, 1938–41, and sintered, 1939–41.
[2] Includes some ore shipped to the abrasive and chemical industries.
[3] Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

The foregoing table shows only shipments to consuming industries of domestic bauxite and excludes foreign ore.

Aluminum.—Consumption of bauxite by the aluminum industry in 1941 increased approximately 82 percent over that in 1940 and comprised 69 percent of all the domestic and foreign ore used. The industry employed dried and undried ore from Arkansas, Alabama, Surinam, British Guiana, the Netherlands Indies, and Brazil. Estimated bauxite consumption in 1942 is expected to be at least 40 percent above that in 1941.

Abrasive and refractory.—Manufacturers of crude aluminous abrasive pigs in Canada and the United States received approximately 64 percent more domestic bauxite in 1941 than in 1940, being consigned 15 percent of all the domestic ore shipped. Except for a small quantity from British Guiana, all of the calcined and sintered ore employed came from Arkansas. The industry's 1942 ore requirements are expected to exceed those of 1941 by about 40 percent. The use of bauxite in refractories is combined with abrasives. In 1941 the consumption of special aluminous refractory products increased substantially in the steel, glass, ship, and other industries.

Chemical.—The chemical industry used 62 percent more bauxite in 1941 than in 1940 and 17 percent of all the domestic and foreign ore consumed. Shipments of domestic bauxite from mines and processing plants to the chemical industry increased 74 percent. Consumption by the industry totaled 295,348 long tons of bauxite, but this includes ore used to make some aluminum chemicals other than those shown in the table. Ore used to manufacture the salts and alumina shown in the table totaled only about 236,900 tons. In addition to bauxite, aluminum salts producers reported consuming 21,841 short tons of alumina (dry equivalent), 4,170 tons of aluminum, and a relatively small quantity of clay, alunite, beryl, and chromite residue. Manufacturers estimated that their 1942 bauxite consumption would exceed that of 1941 by almost 10 percent.

Production and shipments of aluminum salts increased 21 and 22 percent, respectively, in 1941; of alumina (for use other than in aluminum), 106 and 113 percent, respectively. Of this alumina, only 39 percent was consumed by the producers of aluminum salts; the remainder was used in the manufacture of abrasives, refractories, petroleum, spark plugs, glass, rubber, paints,[2] and various other products.

[2] Draper, C. R., Aluminum Compounds in the Paint and Varnish Industry: Paint Technol. (London), vol. 5, Nos. 57, 58, 59, and 60, vol. 6, Nos. 61 and 63; September-December 1940; January and March 1941; pp. 207-208; 229-230, 242, 251-252; 291-292; 13, 20, and 63-64.

Aluminum salts and alumina produced and shipped in the United States, 1940–41

	1940				1941			
	Production	Shipments			Production	Shipments		
	Short tons	Shippers	Short tons	Value	Short tons	Shippers	Short tons	Value
Aluminum salts:								
Alum:								
Ammonia	6,546	7	5,754	$326,736	8,235	7	8,268	$511,414
Potash	2,857	4	2,852	179,020	4,008	5	4,441	297,595
Aluminum chloride:								
Liquid	3,176	6	3,184	136,952	4,250	6	4,399	184,659
Crystal Anhydrous	10,790	4 5	10,755	1,267,827	16,583	4 6	16,180	2,545,373
Aluminum sulfate:								
Commercial:								
General	432,422	17	428,179	8,532,972	513,835	19	517,954	10,647,730
Municipal	11,8[illegible]	10	11,944	185,570	11,670	9	11,768	188,980
Iron-free	24,347	8	23,676	679,356	35,381	10	32,400	1,027,822
Sodium-aluminum sulfate Sodium aluminate	26,674	2 9	27,176	1,574,145	32,078	2 10	30,974	1,979,102
Total aluminum salts	518,673	-------	513,520	12,882,578	626,040	-------	626,384	17,382,675
Alumina [1]	26,070	9	26,284	2,692,411	53,710	11	56,093	5,602,762

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, and monohydrate D, converted to a calcined-alumina equivalent. Figures not comparable with those prior to 1939.

Aluminum salts shipped in, imported into, and exported from the United States, 1937–41

Year	Domestic shipments		Imports		Exports			
					Aluminum sulfate		Other aluminum compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	466,894	$12,092,992	2,864	$61,665	31,807	$679,214	2,609	$423,363
1938	412,905	10,197,354	1,871	40,189	27,715	578,330	1,770	257,545
1939	494,032	11,813,299	828	22,335	34,734	744,755	1,792	208,455
1940	513,520	12,882,578	21	866	43,615	994,861	1,920	271,715
1941	626,384	17,382,675	([1])	231	51,261	1,184,169	2,815	349,951

[1] 147 pounds.

In 1941 the General Chemical Co. started to produce aluminum sulfate in a new plant at Vancouver, Wash., and the Stauffer Chemical Co. built a new plant at Portland, Oreg.

Oil refining, cement, and other.—The use of thermally activated bauxite as an adsorbent and catalyst in the petroleum industry continued to expand in 1941 and is expected to enlarge substantially in 1942 as production of high-octane aviation gasoline increases and the manufacture of synthetic rubber commences. The manufacture of quick-setting, early-strength calcium aluminate cement and the fluxing of ferro-alloys also required more bauxite.

PRICES

In 1941 the average selling price, f. o. b. mines and processing plants, was $4.31 per long ton for crude (undried) bauxite, $5.63 for

crushed dried bauxite, $13.79 for calcined bauxite, and $41.09 for activated bauxite. The average value for all grades of domestic ores as shipped was $5.94 per ton ($5.93 in 1940). The Metals Reserve Co. plans to purchase marginal grades of bauxite in 1942 for the new Arkansas alumina plant on a sliding price scale, providing a bonus for ore high in alumina and a penalty for ore high in silica. Nominal quotations on domestic, chemical, crushed and dried bauxite rose from $6.00–$8.00 in 1940 to $7.00–$8.50 in 1941.

FOREIGN TRADE

Imports of bauxite in 1941 topped the peak set in 1940 by 77 percent, and exports (dry equivalent) advanced 82 percent. Of the imports, 982,515 tons came from Surinam, 84,683 from British Guiana, 36,082 from Netherlands Indies, and 13,266 from Brazil. By customs districts, importations were as follows: 680,827 tons to Mobile, 263,519 to New Orleans, 40,098 to Philadelphia, 10,446 to Massachusetts, 121,648 to Virginia, and 8 to New York. Of the 1941 exports, 119,261 tons were classified as bauxite and other aluminum ores, 15,462 tons as other bauxite concentrates, and 23 tons as alumina; all of these were consigned to Canada, except for less than 1 ton of alumina sent to Brazil.

Bauxite imported into and exported from the United States, 1937–41

Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]		Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1937	507,423	$3,609,063	123,191	$3,456,916	1940	629,552	$4,298,969	81,913	$1,542,708
1938	455,693	3,521,325	57,726	1,459,491	1941	1,116,546	7,475,039	134,746	2,773,877
1939	520,179	3,765,140	51,635	1,117,564					

[1] Also "alumina" as follows: 1937, 182 long tons valued at $16,461; 1938, 64 tons, $5,464; 1939, 1 ton, $432; 1940, 11 tons, $1,743; 1941, 60 tons, $5,544.
[2] Chiefly dried ore. As shipped.

ALUMINUM

PRODUCTION

Primary.—The production of 618,134,000 pounds of primary aluminum in 1941, 50 percent more than in 1940, initiated an aluminum-expansion program destined to reach an annual rate of approximately 2,100,000,000 pounds in 1943, a further advancement of 240 percent. By the end of 1941 the annual production rate totaled approximately 760,000,000 pounds, and in 1942 actual domestic output should total substantially more than 1,000,000,000 pounds. The five aluminum-reduction plants of the Aluminum Co. of America supplied the larger part of the 1941 output. The Reynolds Metals Co. became the first new company to produce primary metal when it began operations at Listerhill, Ala., in June 1941 and at Longview, Wash., in September 1941. Of the Aluminum Co. output, 35 percent was made at Alcoa, Tenn.; 24 percent at Massena, N. Y.; 22 percent at Vancouver, Wash.; 13 percent at Badin, N. C.; and 6 percent at

Niagara Falls, N. Y. Of the Reynolds production, Listerhill, Ala., accounted for 79 percent and Longview, Wash., for 21 percent. Value of the aluminum produced in 1941 averaged 16.24 cents a pound compared with 18.25 cents in 1940. Greater fabricating capacity paced the enlarged metal-producing program.

Although the Government made heavy financial commitments for the expansion of aluminum facilities, virtually all of the increased metal production and fabrication completed by the Aluminum Co. of America during 1941 resulted from expenditures of the company's own money (a $215,000,000 expansion program was begun in 1937). Funds for plants of the Reynolds Metals Co. were obtained from the Reconstruction Finance Corporation, which took the company's existent aluminum-fabricating facilities as security. On June 27, 1941, the Government announced that more aluminum would be needed to fulfill Army-Navy and Lend-Lease requirements, and late in the summer of 1941 it began to let contracts for the construction and operation of its own aluminum plants through the Defense Plant Corporation.[3]

The first Government expansion program (of June 27, 1941) for 303,000 short tons of aluminum was followed by a second expansion program (announced February 26, 1942) providing for an additional 320,000 tons of metal. The Aluminum Co. of America was the first company to enter into a contract with the Defense Plant Corporation (August 19, 1941) for the construction and operation of a 200,000-ton (annual) alumina plant (later extended to 500,000 tons and recently expanded again to 650,000 tons) at Hurricane Creek, near Bauxite, Ark., utilizing low-grade bauxite and of three reduction plants to produce a total of 160,000 tons of aluminum. The Aluminum Co. also agreed to build additional plants to be operated by others. The contract provides that the company design and construct the plants at cost but without fee or profit and that it operate them under a 5-year lease and pay the corporation 85 percent of the net profits from operation. Either party can extend its own capacity; the lease can be canceled; and an adjustment in price of the metal will be made if unreasonable profits are attained. In concluding negotiations the Aluminum Co. of America agreed to reduce the price on ingot aluminum after September 30, 1941, from 17 cents to 15 cents a pound.

The Office of Production Management originally recommended that the remainder of the aluminum-producing capacity under the first expansion be divided among four other companies—Reynolds Metals Co., Olin Corporation, Bohn Aluminum & Brass Co., and Union Carbide & Carbon Co. This program did not materialize exactly as planned, and only the first two of these firms decided to enter into the production of primary aluminum. Reynolds finally decided to add only 27,000 tons of capacity to its Listerhill works, and Olin was allocated 15,000 tons, which later was increased to 20,000 tons. Olin's subsidiary, Kalunite, Inc., was authorized to build a 10,000-ton alumina plant based upon alunite, which later was extended to 30,000-ton capacity. The Aluminum Co. was allocated the production capacity that remained on the first expansion program, which when revised to conform to the company's standard design brought its share of this program to 256,000 tons.

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[3] Franke, Herbert A., The Aluminum Situation: Min. and Met., vol. 22, No. 419, November 1941, pp. 528-532.

As the War Production Board (which superseded the Office of Production Management January 24, 1942) realized that the vast increase in the Nation's aluminum facilities would still not be enough to assure essential materials for the greatly increased aircraft, munition, and other vital war programs, plans were announced for a second expansion in aluminum facilities. This provided for three new reduction plants and extensions to three others, and for another alumina plant. All of this capacity was turned over to the Aluminum Co. for construction and operation. The table shows the existent and projected alumina and aluminum program (as of August 1, 1942), which, when completed, will give the Government ownership of 51 percent of the alumina and 57 percent of the aluminum capacity of the country.

Projected annual alumina- and aluminum-producing capacity of the United States in 1943, in thousands of short tons

Operating company and plant location	Alumina capacity		Aluminum capacity	
	Company-owned	Government-owned	Company-owned	Government-owned
Aluminum Co. of America:				
East St. Louis, Ill	383			
Mobile, Ala	657			
Hurricane Creek (Bauxite), Ark		[1] 650		
Baton Rouge, La		[2] 500		
Alcoa, Tenn			149	
Massena, N. Y			73	[1] 48
Niagara Falls, N. Y			20	
Badin, N. C			45	
Vancouver, Wash			84	
Troutdale, Oreg				[1,2] 64
Los Angeles, Calif				[1,2] 80
Jones Mills, Ark				[1] 64
Mead (near Spokane), Wash				[1,2] 96
Maspeth, L. I., N. Y				[2] 128
Burlington, N. J				[2] 48
Modesto, Calif				[2] 48
Reynolds Metals Co				
Listerhill, Ala	[3] 95		[1,3] 45	
Longview, Wash			[3] 27	
Kalunite, Inc., Salt Lake City, Utah		[1] 30		
Olin Corporation, Tacoma, Wash				[1] 20
Total capacity	1,135	1,180	443	596

[1] First expansion program.
[2] Second expansion program.
[3] Government-financed.

Under its own privately financed program the Aluminum Co. of America started or completed during 1941 and the early part of 1942 expansion of aluminum reduction facilities at Alcoa, Tenn., Badin, N. C., and Vancouver, Wash.; another addition to its alumina plant at Mobile, Ala.; more capacity to produce castings (13,800 tons more a year), forgings (19,200 tons), extrusions (3,000 tons), tubing (18,000 tons), and rivets (1,000 tons); a large, new, strong-alloy sheet mill of 180,000 short tons capacity a year at Alcoa, Tenn.; a second blooming and rod mill at Massena, N. Y., to supply 120,000 tons a year of forging stock and rod, bar, and wire; the stripping of large bodies of bauxite ore at Bauxite, Ark.; two rotary bauxite-drying kilns and mining equipment at Bauxite, Ark.; bauxite drying and mining capacity at Moengo Hill and Paranam, Surinam; acquisition of eighty 70-ton covered hopper railroad cars on a 5-year lease and ten new ore-carrying vessels;

and construction of a dam and power house of 27,000 Kv.-a. at Glenville, N. C., and of a hydroelectric project of 54,000 Kv.-a. at Nantahala, N. C. In August 1941 the company voluntarily turned over to the Tennessee Valley Authority for coordinated operation or integration its five hydroelectric developments on the Little Tennessee River and also transferred to it the great Fontana dam site, where the Government is now constructing a 225,000-kilowatt hydroelectric plant. In February 1942 cabling machinery at Massena, N. Y., made idle by the diversion of aluminum to more essential war purposes, was sold to the Anaconda Wire & Cable Co.

Under the aluminum expansion programs initiated by the Government, the Aluminum Co. of America undertook to design, construct, and operate all the new capacity proposed under the first- and second-expansion programs (or for 1,150,000 tons of alumina and 576,000 tons of aluminum) except for 30,000 tons of alumina and 47,000 tons of aluminum allocated to Kalunite, Inc., Olin Corporation, and Reynolds Metals Co. In addition to alumina- and aluminum-producing plants, the expansion programs provide for more fabricating, carbon electrode, synthetic cryolite, aluminum fluoride, power, and other capacity. The power program includes construction of a new steam-electric generating plant with 80,000-kilowatt output and a gas-engine-powered D. C. generating plant of 81,000-kilowatt installed capacity at Jones Mills, Ark. Extension of fabricating capacity involves the production of more forgings, rivets, extrusions, wire, rod, bar, tubing, and sheet (including high-strength alloy sheet). Outstanding among the fabricating projects are two Government-financed aluminum sheet mills—at Chicago, Ill. (of 120,000-ton annual capacity), designed and constructed by the Aluminum Co., and at Spokane, Wash. (of 120,000-ton capacity), designed and constructed by the United Engineering & Foundry Co. (except for ingot casting and furnaces, which will be designed and installed by the Aluminum Co.).

A strike of Congress of Industrial Organizations workers at the Edgewater (N. J.) rolling mill of the Aluminum Co. lasted from March 12 to March 24, 1941. On April 26, 1941, the company made a general wage (and salary) increase to all its employees which amounted to 10 cents an hour when added to that of October 1, 1939. In June 1941 the aluminum and aircraft programs again were threatened with strikes. Congress of Industrial Organizations workers walked out at the Cleveland plant of the Aluminum Co. (and the Detroit plants of the Bohn Aluminum & Brass Co.) demanding further wage increases. The Cleveland strike ended after 2 days and resulted in a 1-cent-an-hour wage increase. After 10 days the Detroit strikers returned to work and submitted their wage demands to further negotiations before the National Defense Mediation Board. In July 1941 the Congress of Industrial Organizations demanded that an 18-cent-an-hour sectional wage differential between workers in northern and southern aluminum plants be eliminated. After other negotiations failed and a strike threatened, the case was certified to the National Defense Mediation Board on August 16, 1941. On February 12, 1942, the National War Labor Board ordered gradual elimination of the wage differential between the Aluminum Co.'s northern and southern plants, which was accepted by the company

"under protest." The Board also ruled that a premium should be paid for night work.

In October 1941 Federal Judge Francis G. Caffey handed down a decision on the monopoly charges filed against the Aluminum Co. of America by the Antitrust Division of the Department of Justice on April 23, 1937. The decision favored the company and cleared it of the charges of monopoly, conspiracy, and other violations of the Sherman Act. Monopolization charges covered bauxite, water power, alumina, virgin aluminum pig and ingot, castings, cooking utensils, pistons, extrusions and structural shapes, foil, miscellaneous fabricated articles, sheets, and cables. The judge reserved jurisdiction for the court on the matter of selling sheet and cable below cost to restrain competition or to compete with copper. He ruled that there was no conspiracy between the Aluminum Co. and Aluminium, Ltd., or any foreign producer and that the charges of misconduct were not pertinent to the Sherman Act. On December 17, 1941, Judge Caffey denied Assistant Attorney General Thurman Arnold's motion to have the court's oral decision on the case designated as the court's findings of fact and conclusions of law for the purpose of speeding appeals before the United States Supreme Court because he held that the charges of price fixing, monopoly, and restraint of trade alleged by the Government had not been sustained.

During 1941 the Reynolds Metals Co., Federal Reserve Bank Building, Richmond, Va., completed an aluminum plant (95,000 tons annual capacity) and aluminum reduction plants at Listerhill, Ala. (18,000 tons), and Longview, Wash. (27,000 tons). Reynolds aluminum-fabricating facilities were greatly increased in capacity by one sheet-rolling mill and one rod and shape mill at Listerhill, and one sheet-rolling mill, one rod mill, and one extrusion plant at Louisville, Ky. The company expansion program provides for enlargement of the reduction plant at Listerhill and increasing its ingot capacity to 45,000 tons, which is scheduled to be brought into operation during the summer of 1942. The company further mortgaged its plants to secure Reconstruction Finance Corporation loans for expansion of its aluminum program. Arrangements with the Defense Plant Corporation provided for the 24,000-ton aluminum-alloy extrusion plant at Lousiville, Ky., and for the 39,000-ton aluminum-alloy sheet and blooming mill at Listerhill, Ala. The fabricating facilities at Listerhill are operated under the name of the Reynolds Alloys Co.

Reynolds is reported to have prospected, drilled, and proved reserves of over 3,000,000 tons of domestic bauxite. In May 1941 Reynolds signed a 12-year contract with the N. V. Billiton Maatschappij for 6,000,000 tons of Surinam bauxite in addition to the earlier provision for bauxite made with the same company for shipments from Bintan, Netherlands Indies, and one made with the Companhia Geral de Minas of Brazil. The first ore shipments from Surinam are expected to arrive in the summer of 1942. The company is opening an underground mine in Arkansas which will commence producing bauxite for the Government alumina plant there late in the fall of 1942.

The Olin Corporation, East Alton, Ill., owner of the Western Cartridge Co., began construction of a 20,000-ton aluminum reduction plant at Tacoma, Wash., which is scheduled to begin production

early in the fall of 1942. Its subsidiary (Kalunite, Inc.) began work on an alumina plant of 30,000 tons capacity at Salt Lake City, Utah, to use alunite from Marysvale, Utah. The Bureau of Mines made a survey [4] which indicated domestic reserves of alunite totaling 9,400,000 short tons, contained in 21,900,000 tons of rock averaging a minimum of 30 percent alunite. Reserves of high-grade material, containing 50 percent minimum alunite content, were estimated at only 2,400,000 tons, contained in 3,350,000 tons of rock.

Other companies which expanded or were enlarging facilities in connection with the aluminum program (chiefly through the Defense Plant Corporation) were: Extruded Metals Defense Corporation—a 21,000-ton (annual) aluminum-alloy extrusion plant at Grand Rapids, Mich.; Bohn Aluminum & Brass Corporation—a 22,000-ton aluminum-alloy extrusion plant at Adrian, Mich., and another of 7,800-ton capacity at Los Angeles, Calif.; Willys Overland Motors, Inc.—a 1,800-ton aluminum-alloy forging plant at Toledo, Ohio; Chrysler Corporation and Ford Motor Co.—aluminum-alloy forging facilities at Detroit and Dearborn, Mich., respectively; General Motors Corporation—forging plants at Saginaw, Mich., and Muncie, Ind.; Naval Aircraft Factory and the Weatherhead Co.—forging plants at Philadelphia, Pa., and Cleveland, Ohio, respectively; National Bronze & Aluminum Foundry Co. and Packard Motor Car Co.—aluminum-alloy casting facilities at Cleveland, Ohio, and Detroit, Mich., respectively; Pennsylvania Salt Mfg. Co.—a 10,000-ton synthetic cryolite and 3,000-ton aluminum fluoride plant at Cornwells Heights, Pa.; General Chemical Co.—an aluminum fluoride plant at Marcus Hook, Pa.; and Revere Copper & Brass, Inc.—a 27,000-ton aluminum-alloy forging plant at Rome, N. Y.

Secondary.—Recovery of secondary aluminum in 1941 totaled 106,857 short tons compared with 80,362 tons in 1940 and 53,947 tons in 1939. The 106,857 tons recovered from secondary sources included 8,308 tons of pure metal (98.5+ percent), 97,614 tons of aluminum alloys, and 935 tons of aluminum in chemical products (784 in aluminum chloride and 151 in aluminum sulfate). Production in the form of secondary aluminum ingot totaled 83,933 tons (68,489 in 1940). The secondary aluminum recovered in 1941 required the consumption of 126,447 tons of aluminum scrap, 45,329 tons or 36 percent of which was old scrap (53,265 tons or 57 percent in 1940), and 81,118 tons or 64 percent new scrap (39,587 or 43 percent in 1940). Remelters, smelters, and refineries used 79 percent of this scrap; aluminum rolling mills, 13 percent; and foundries and other manufacturers, 8 percent.

CONSUMPTION

Apparent domestic consumption of primary aluminum in 1941 advanced 33 percent over that in 1940. Consumption of secondary aluminum increased at approximately the same rate.

[4] Thoenen, J. R., Alunite Resources of the United States: Bureau of Mines Rept. of Investigations 3561, 1941, 48 pp.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1937–41

Year	Primary aluminum					Secondary aluminum	
	Production		Imports (pounds)	Exports (pounds)	Apparent consumption [1] (pounds)	Pounds	Value [2]
	Pounds	Value					
1937	292,681,000	$55,609,000	[3] 45,178,069	5,383,516	335,958,553	125,120,000	$23,773,000
1938	286,882,000	56,659,000	[3] 17,740,281	12,618,078	179,045,203	77,600,000	15,326,000
1939	327,090,000	64,600,000	18,579,940	73,264,458	335,291,482	107,894,000	21,309,065
1940	412,560,000	75,292,000	34,870,887	53,771,478	454,034,409	160,724,000	29,332,130
1941	618,134,000	100,395,000	26,715,155	14,808,924	605,577,231	213,714,000	34,707,153

[1] Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stocks totaled 3,483,000 pounds in 1937, 62,886,000 in 1939, and 60,375,000 in 1940; additions to producers' stocks totaled 112,959,000 pounds in 1938 and 24,463,000 in 1941

[2] Based upon average price of primary aluminum as reported to Bureau of Mines.

[3] Crude and semicrude, some of which may be secondary aluminum.

Of the primary metal consumed in 1941, the transportation industry used 63 percent compared with 40 percent in 1940 and only 29 percent from 1933 to 1938. The aviation industry employed the greater part of that used in the transportation field plus a considerable portion of the 19 percent allocated to the foundry and metal-working business. Production of military and commercial aircraft in the United States in the first month of each year had increased from 157 in 1939 to 279 in 1940 and 1,107 in 1941. In September 1941 production totaled 1,942 planes and on June 26, 1942, the President announced that the output for May 1942 reached nearly 4,000 planes. The President's airplane-production program announced January 6, 1942, calls for 60,000 planes in 1942 and 125,000 in 1943—45,000 and 100,000, respectively, of the heavier combat type. Aluminum is said to constitute 54 to 80 percent of the weight of an airplane (including the motor). The percentage break-down of primary aluminum used by industry in 1941 was approximately as follows: Transportation (air, water, and land), 63 percent; foundry and metal working, 19 percent; machinery and electrical appliances, 6 percent; chemical, 5 percent; building construction, 3 percent; ferrous and nonferrous metallurgy, 2 percent; and cooking utensils, 1 percent. No new metal was used for the manufacture of electrical conductors and food and beverage products. According to the American Iron and Steel Institute, the steel industry consumed 3,957,359 pounds of aluminum in October 1941 (averaging 0.562 pound per ton of steel), and it will need about 60,000,000 pounds of aluminum annually, chiefly to deoxidize and purify molten steel. Remelted aluminum scrap satisfies the major part of these requirements.

PRICES

Despite the great demand for aluminum, on October 1, 1941, the Aluminum Co. of America reduced the base price of primary aluminum 2 cents, bringing down the open-market quotation in New York for

lots of 10,000 pounds or more, 99-percent plus pure ingot aluminum, delivered, to 15 cents a pound. The new price included the extension of additional transportation allowances on shipments of ingot and

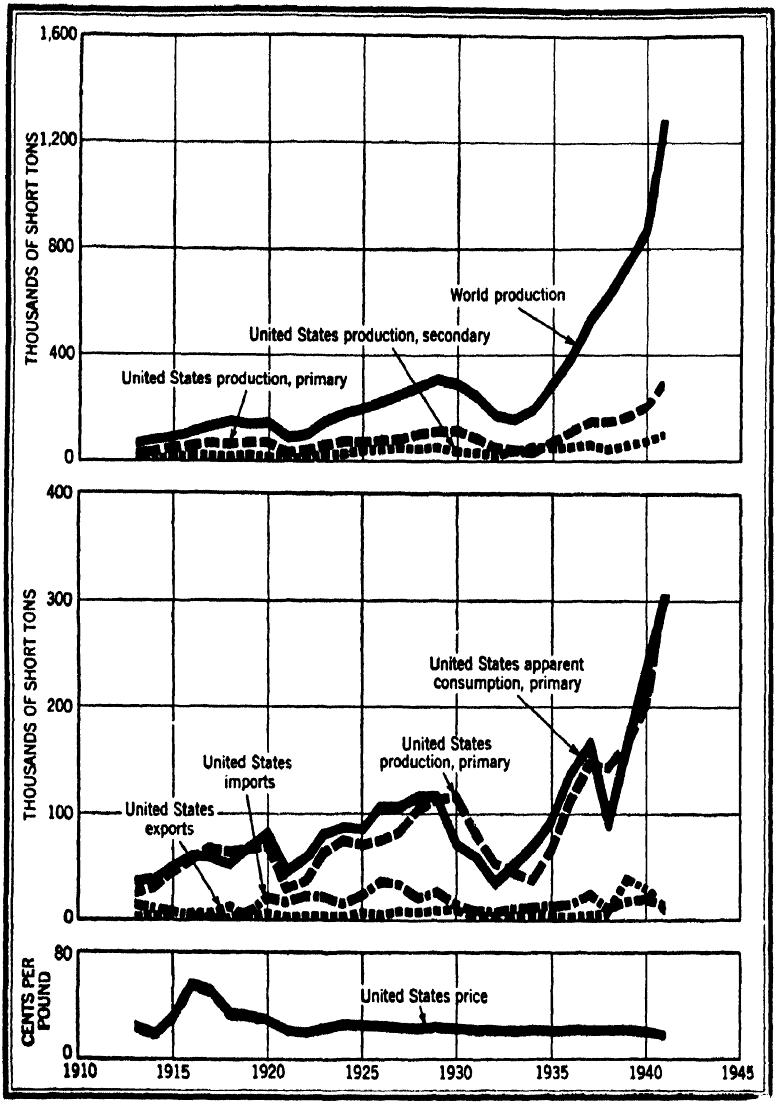

FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913–41. Price is for No. 1 virgin 98–99 percent at New York through 1929, thereafter for 99-percent-plus virgin ingot, as reported by American Metal Market.

certain basic fabricated products to destinations west of the Mississippi River. Deductions allowed for transportation charges on orders of 500 pounds or more of one product cannot exceed the lowest carload rate of rail freight.

Within less than 2 years the price of aluminum has dropped 5 cents—from 20 cents a pound to 19 cents on March 25, 1940; from 19 cents to 18 on August 1, 1940; from 18 cents to 17 on November 18, 1940, and from 17 cents to 15 on October 1, 1941. Corresponding reductions in fabricated products also were made, and in May 1942 the Office of Price Administration announced that in August 1942 the Aluminum Co. would make further substantial reductions in its prices of fabricated products, particularly sheet, castings, and forgings. The price reductions on aluminum are attributed to massproduction, manufacturing improvements, and lower operating costs arising from research.

Chaotic conditions prevailed in the secondary or scrap-aluminum industry early in 1941 owing to the 1940 price reductions on primary aluminum and the maximum price schedules set by the Office of Price Administration and Civilian Supply. The Government set a maximum price of 11 cents on cast and forged scrap when sold by makers, 12 cents when sold by dealers, and 13 and 14½ cents, respectively, on pure clippings and cable, f. o. b. point of shipment. Prices of 17 cents and 16 cents, respectively, were established on secondary aluminum ingot 98 percent pure and on No. 12 alloy. According to Metal Statistics, 1942, dealers' buying prices per pound in New York for the principal grades of domestic aluminum scrap in 1941 averaged 10.76 cents for cast aluminum (8.95 cents in 1940) and 13.00 cents for new aluminum clippings (14.47 cents in 1940). The average selling price of remelted metal, 98½ to 99 percent grade, was 17.36 cents (18.74 cents in 1940), and of No. 12 alloy, No. 2 grade, 16.37 cents (14.66 cents in 1940).

FOREIGN TRADE

Imports and exports of crude and semicrude aluminum in 1941 were 26 and 73 percent less, respectively, than in 1940. The value of imports and exports of manufactured aluminum products decreased 51 and 54 percent, respectively. Imports (exclusive of scrap) constituted only 4 percent of the apparent consumption of primary aluminum in 1941. Of the imports of crude (12,830 short tons), 12,802 tons came from Canada and 28 from Chile; of semicrude (528 tons), all came from Canada; and of scrap (55 tons), 20 tons came from Cuba, 11 from Mexico, 6 from the United Kingdom, 5 from Jamaica, and 1 from Canada.

Of the crude aluminum exported in 1941 (750 short tons), 331 tons went to Brazil, 178 to Argentina, 45 to the United Kingdom, 83 to Canada, 28 to the Netherlands Indies, 26 to the Union of South Africa, 19 to China, 17 to Hong Kong, and 16 to Uruguay; of semicrude (6,655 tons), 2,903 tons went to the United Kingdom, 1,779 to U. S. S. R., 1,261 to Australia, and 201 to Canada; and of scrap (57 tons), 34 tons went to Canada and 21 to Brazil.

Aluminum imported for consumption in the United States, 1939–41, by classes

Class	1939		1940		1941	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Metal and alloys, crude	17,967,167	$2,490,571	34,869,763	$4,628,601	25,659,083	$3,333,642
Scrap	10,092,927	760,913	1,296,738	108,035	109,302	13,440
Plates, sheets, bars, etc	612,773	133,629	1,124	592	1,056,072	271,675
	28,672,867	3,385,113	36,167,625	4,737,228	26,824,457	3,618,757
Manufactures:						
Leaf (5½ by 5½ inches)	(1)	26,003	(1)	12,138	(1)	14,825
Powder in leaf (5½ by 5½ inches)	(2)	90			(2)	74
Bronze powder and powdered foil	100,995	42,959			44,564	28,044
Foil less than 0.006 inch thick	2,827,010	1,266,436	941,004	389,868	234,699	110,166
Table, kitchen, hospital utensils, etc	26,776	16,191	8,568	5,149	4,809	3,620
Other manufactures	(3)	29,468	(3)	15,541	(3)	52,057
	(3)	1,381,147	(3)	422,696	(3)	208,786
Grand total	(3)	4,766,260	(3)	5,159,924	(3)	3,827,543

[1] 1939: 13,589,224 leaves; 1940: 10,244,034 leaves; 1941: 11,113,500 leaves; equivalent in pounds not recorded.
[2] 1939: 70,000 leaves; 1941: 50,000 leaves; equivalent in pounds not recorded.
[3] Quantity not recorded.

Aluminum exported from the United States, 1939–41, by classes

Class	1939		1940		1941	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Ingots, slabs, and crude	56,247,255	$11,533,919	24,453,795	$5,352,151	1,499,052	$325,218
Scrap	951,662	160,283	1,910,723	331,757	114,222	22,352
Plates, sheets, bars, etc	17,017,203	9,197,953	29,317,683	12,235,124	13,309,872	4,445,018
	74,216,120	20,892,155	55,682,201	17,919,032	14,923,146	4,792,588
Manufactures:						
Tubes, moldings, or other shapes	1,370,419	977,296	2,465,068	1,273,793	733,934	550,606
Table, kitchen, and hospital utensils	537,532	302,406	841,845	482,869	595,802	281,851
Foil	1,133,031	488,010	2,808,535	1,221,590	547,489	246,259
Powders and pastes (aluminum and aluminum bronze)	182,323	80,960	879,342	370,061	[1] 478,308	[1] 206,776
Other manufactures	(2)	964,423	(2)	1,169,780	(2)	794,442
	(2)	2,813,095	(2)	4,518,093	(2)	2,079,934
Grand total	(2)	23,705,250	(2)	22,437,125	(2)	6,872,522

[1] Aluminum content. [2] Quantity not recorded.

TECHNOLOGIC DEVELOPMENTS

Outstanding developments in technology in 1941 centered about the mass production of aluminum—the greatly increased recovery of ingots; the fabrication, upon a volume basis, of aluminum-alloy sheet, forgings, castings, rods, bars, and rivets; and the advancements in using low-grade bauxite, alunite, and clay.

One of the most important advancements in technology in the aluminum industry probably is under way at the Government's new

Hurricane Creek alumina plant near Bauxite, Ark. A combination Bayer and lime-soda-sinter process has been developed that is expected to yield a much higher percentage recovery of the alumina contained in bauxite.[5] Low-grade Arkansas bauxite will be used, which probably will average 13 to 14 percent silica compared with currently used high-grade Arkansas and South American bauxite averaging only about 5 percent silica. In the process developed by the Aluminum Co. in its East St. Louis pilot plant, high-silica bauxite (actually bauxite and clay) will be treated directly by the Bayer process (without prior washing) and the tailings or red mud subjected to a lime-soda sintering operation requiring the addition of lime and some soda ash. The sintered product will be leached and its liquors added to the Bayer process liquors. The Bayer process also has been improved by adding starch to the caustic soda solution to assist settling (U. S. Patent 2,280,998).

At Salt Lake City, Utah, a plant is under construction that will use the Kalunite process to extract alumina from alunite[6] or aluminum-bearing clays. By this process, crushed alunite rock (containing at least 20 percent alumina) first is roasted to drive off combined water, and the soluble residue is dissolved in a mixture of sulfuric acid and return liquor. Potassium alum is crystallized from the solution and decomposed in an autoclave to form basic alum and dilute sulfuric acid. The basic alum then is decomposed by heating to 1,000° C. Potassium sulfate is leached from this sintered residue, leaving the insoluble finished alumina. Potash and sulfur dioxide are obtained as byproducts.

Further developments in progress on the recovery of alumina from domestic raw materials include work by the Phelps Dodge Corporation on the fines from Morenci copper-ore mill tailings (potash-alum process); the Monolith Portland Cement Co. on clay (a lime-soda sinter process producing alumina and cement); the Tennessee Valley Authority on clay (a sulfuric acid process); Kalunite, Inc., on clay and alunite (sulfuric acid process); the War Metallurgy Committee of the National Academy of Sciences and the Bureau of Mines on clay and alunite (modified Pedersen process); the Aluminum Co. of America on clay and Bayer-process red mud (lime-soda treatment); and the Bureau of Mines on lime-soda sintering of high-silica bauxite and clay as well as on beneficiation of bauxite and alunite. To date, the Bureau's work on the beneficiation of submarginal bauxite shows that for some ores careful grinding and desliming suffices, other ores require gravity concentration to remove iron and titanium minerals, and still other bauxites require flotation or flotation and gravity concentration. Oleic acid and paper-mill fatty acid (tallol) proved the best reagents to collect the gibbsite, the principal extractable alumina mineral in bauxite.[7] Tests of the Seailles alumina process for the treatment of high-silica bauxite indicated that it was impracticable and uneconomic. By means of flotation, alunite was readily separated from quartz, the principal impurity.[8] The Bureau worked out

[5] Advisory Committee to W. P B. on Metals and Minerals of the National Academy of Sciences, Alumina from Low-Grade Bauxite, Alunite, and Clay: Metal Progress, vol. 42, No. 2, Aug. 1942, pp. 197-200.

[6] Eichelberger, Frank, Aluminum from Western Alunites: Min. Cong. Jour., vol. 27, No. 11, November 1941, pp. 37-39.

[7] Clemmer, J. B., Clemmons, B. H., and Stacy, R. H., Preliminary Report on the Flotation of Bauxite: Bureau of Mines Rept. of Investigations 3586, 1941, 26 pp.

[8] Gabriel, Alton, and Dasher, John, Beneficiation of Alunite: Bureau of Mines Rept. of Investigations 3610, 1942, 20 pp.

the details of a lime-soda-sinter process and assembled it in the form of a flow sheet, and construction of a pilot plant based upon it was begun. Work to date indicates that a lime-soda-sinter or a lime-sinter-soda-extract process may prove most practicable for the recovery of alumina from clay. A method developed by Arthur Hixson of Columbia University for the extraction of alumina from clay (U. S. Patent 2,249,761) involves roasting and subsequent treatment with hydrochloric acid and isopropyl ether, and one by Alfred R. Globus specifies the treatment of clay with sulfuric acid and then with excess sodium hydroxide.

Despite some advantages claimed for the Soderberg electrode,[9] it has been found more expedient in the expansion program to use chiefly the old-style pots and prebaked carbon block electrodes. Remelters increased the recovery of aluminum from scrap in 1941 by briquetting before melting and by using fluxes.[10] Additional research is recommended on prevention of the explosibility of aluminum powder and other metal dusts.[11] Improvements in methods of converting power from alternating to direct current by means of the mercury rectifier have greatly facilitated the rapid growth of the aluminum and other electrochemical industries.[12] The use of bauxite as a catalyst and catalyst carrier and of anhydrous aluminum chloride[13] in the production of high-octane aviation gasoline increased in importance.

Representative of the trend in fabrication is the new, mile-long, semicontinuous hot-strip mill (North mill) of the Aluminum Co. of America at Alcoa, Tenn., which simulates hot-strip steel roll-mill practices. Strong aluminum-alloy sheet 48 to 120 inches wide can be rolled for the aircraft industry at the North mill at the rate of 180,000 tons annually by means of a two-high, reversible, hot-roll mill followed by a single-stand and a four-stand tandem mill. The strong-alloy sheet mill of the Reynolds Metals Co. at Listerhill, Ala., also depicts a more modern trend in aluminum fabrication. This plant includes a single-stand hot reversible mill, a single-stand cold, and a four-stand cold mill. A new technique is the mass production of compound curved surfaces in sheet, as for large airframe skin panels, in which forming takes place by controlled drawing actions applied to a moving sheet while it travels at selected speeds.[14] There was a trend in favor of forgings in place of sand castings in 1941, and the use of press rather than hammer forgings increased for small articles. More hot-pressed or kneaded forging stock went into the manufacture of crankcases and other aircraft products. Development of forged or pressed aircraft cylinder heads by the Wright Aeronautical Corporation showed great promise. The firm uses hydraulic mechanical presses and upsetters instead of drop hammers on aluminum-alloy cast ingot or extruded bar stock.[15] To take care of the great demands for forging stock and rods, bars, and wire, the

[9] Noton, C. H., The Söderberg Electrode: Ind. Chem (London), vol. 17, No. 196, May 1941, pp. 115–116.

[10] Steel, Increasing Recovery from Aluminum Scrap. Vol 110, No 9, March 2, 1942, p. 85.

[11] Brown, Hylton R., Dust-Explosion Hazards in Plants Producing or Handling Aluminum, Magnesium, or Zinc Powder: Bureau of Mines Inf. Circ. 7148, 1941, 11 pp.

[12] Cox, J. H., and Bohn, D. I., Power Rectification in Aluminum: Chem. and Met. Eng., vol. 48, No. 9, September 1941, pp. 108–110. Rhea, T. R., Mercury Arc Rectifiers for Electrochemical Installations: Chem. Ind. vol. 49, No. 7, December 1941, pp. 814–816.

[13] Thomas, C. A., Anhydrous Aluminum Chloride in Organic Chemistry: Am. Chem. Soc. Mono. Ser. 87, 1942, 972 pp.

[14] Anderson, Frohman, Forming-by-Drawing: Aviation, vol. 41, No. 6, June 1942, pp. 82–85.

[15] Aviation, Forged Cylinder Head Developed by Wright: Vol. 41, No. 6, June 1942, pp. 117, 263.

Aluminum Co. started construction of a second, and plans for a third, blooming mill. Although production of extrusions increased, the advance probably was not as great as that in Europe, where extruded products are widely used as forging stock. During 1941 sand casting foundries were more highly mechanized, and there was a trend toward the mass and straight-line production of only one product, such as cylinder heads, in a single plant (as by Buick, Ford, and Aluminum Co.). The Antioch plaster-mold process for the production of highly stressed aluminum castings to unusually close tolerances was further improved.[16] The manufacture of permanent mold [17] and die castings increased substantially, largely because of the aircraft program. Many zinc die-casting machines were converted to produce aluminum-alloy castings. The production of rivets greatly increased, and new blind or pull-through and explosive rivets [18] were introduced for airplane work in places that are not readily accessible. Mass fabrication led to better understanding of the aluminum alloys, of which 24S (both bare and Alclad) was the most widely used. Alloys 2S, 3S, and 52S, available in controlled tempers, were produced by cold-work from hot-mill slab, while alloys 17S and 24S were heat-treated and aged at room temperatures and alloys 53S, and 61S were heat-treated and artificially aged at moderately elevated temperatures to develop maximum strength. Tests showed that aluminum-base alloys containing varying amounts of magnesium usually exhibit marked resistance to the action of alkaline corrosion.[19] Spot welding of aluminum alloys was applied more to stressed members of airframes.[20]

NATIONAL DEFENSE AND WAR MEASURES

When it became obvious that aluminum requirements for military purposes had been underestimated, the Office of Production Management placed the metal under mandatory priorities—on February 24, 1941.[21] This order, No. M-1, effective March 22, 1941, was superseded by No. M-1-f, on February 14, 1942, which further restricted the delivery, processing, use, and inventories of aluminum. Ceiling prices were set on scrap and secondary ingot during March 1941 by the Price Stabilization Division of the Office of Production Management in order to maintain price stability and prevent excessive and speculative price increases. This price order was amended in May, June, August, October, and November 1941. Regulations governing the disposition and use of aluminum scrap were promulgated April 11, 1941, in Order M-1-b, which was amended June 10, 1941 (Order M-1-c) and January 7, 1942 (Order M-1-d). A survey by the Bureau of Mines in April 1941 showed that domestic bauxite production could be increased from limited reserves in an emergency.

The National Academy of Sciences began an investigation of possible substitutes for aluminum early in 1941, and in May 1941 it was

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16 Kay, R Raymond, Precision Aluminum Castings· Iron Age, vol. 149, No. 15, April 9, 1942, pp. 50-54.
17 Fahlman, E. G., and Chase, Herbert, Aluminum Permanent Mold Castings: Iron Age, vol. 149, No. 17, April 23, 1942, pp. 36-42.
18 Iron Age, Explosive Rivets for Aircraft: Vol. 148, No. 3, July 17, 1941, pp. 54-55.
19 Benson, L. J., and Mears, R. B., Aluminum-Magnesium Alloys Resist Attack. Chem. and Met. Eng., vol. 49, No. 1, January 1942, pp. 88-91.
20 Chiles, Harry L., Spot-Welding Aluminum at Lockheed: Iron Age, vol. 149, No. 5, January 29, 1942, pp. 29-33.
21 Fortune, Aluminum and the Emergency: Vol. 23, No. 5, May 1941, pp. 66-68, 142, 145-146, 150, 152, 164b.

announced that civilian and nonessential uses for the metal would be seriously curtailed as the armed forces would absorb virtually the entire metal output. As a result of the President's new heavy-bomber program, aluminum began to present a more serious problem. Apparently military needs had not been fully appreciated. Underestimation of requirements and the shortage were laid in part to failure to provide adequate working inventories for processing of the metal, to foresee the extent of indirect military needs, to obtain aluminum scrap from secondary markets, and to make allowance for the reduction in imports from Canada.

In June 1941 the Office of Production Management directed the Office of Civilian Defense to conduct a Nation-wide collection of old and unwanted aluminum. The campaign, however, was disappointing, as an anticipated collection of 20,000,000 pounds of aluminum actually yielded only 11,173,979 pounds of scrap, which contained but 6,398,051 pounds of recoverable aluminum. The poor yield was attributed to inadequate preparation by the Office of Civilian Defense and to the fact that cooperation from scrap dealers was not requested.

On June 27, 1941, the Office of Production Management made recommendations for the first aluminum-expansion program—to increase domestic aluminum productive capacity to 1,400,000,000 pounds and to procure an additional 200,000,000 pounds of metal from Canada. The alumina capacity provided for in this program was subsequently increased from 400,000,000 pounds to 1,300,000,000. Contracts and commitments for the construction of these new plants began to be let in August 1941 by the Defense Plant Corporation. The first contract was made with the Aluminum Co. of America.

In the fall of 1941 punitive action was taken against violators of aluminum priorities—companies that had diverted much-needed aluminum from vital defense or war production to nonessential uses. The aluminum program was threatened several times by strikes as well as by the shortage of boats for bringing bauxite from South America. High priority ratings for necessary materials were granted by the Division of Priorities for the construction of new aluminum plants.

On January 23, 1942, Conservation Order M-1-e became effective, prohibiting the use of aluminum except in the manufacture of specific items. Rearrangement of maximum prices for aluminum "plant" scrap were made by the Office of Price Administration on January 13, 1942, to facilitate operation of the segregation order (M-1-d), issued January 7, 1942. On March 10, 1942, allocations were placed on aluminum paint and pigments (Order M-1-g). In February 1942 the Director of Industry Operations of the War Production Board (formerly Office of Production Management) ordered all idle aluminum inventories in the hands of fabricators sold to the Government. On February 16, 1942, the United States Department of the Interior proposed a vast expansion program for mineral and power developments in the West, which included the aluminum industry.

On February 26, 1942, the Aluminum and Magnesium Branch, Division of Materials, War Production Board, announced a second aluminum expansion program to assure the Nation a supply of metal ample to produce the airplanes requested by the President. This program provided for an increase in annual domestic aluminum production capacity to 2,100,000,000 pounds, which (with Canadian

imports) should make available a supply of over 2,500,000,000 pounds of primary metal a year. The contracts made May 2 and July 15, 1941, by the Metals Reserve Co. with the Aluminum Co. of Canada, Ltd., call for the total delivery of 340,000 metric tons of aluminum before the end of 1944. The new expansion program also involves the annual remelting and reworking of about 400,000,000 pounds of recovered scrap and a very considerable increase in fabricating facilities.

In May 1942 the three reduction plants provided by the first Government expansion program began operations. The Metals Reserve Co. started purchasing high-silica Arkansas bauxite in the spring of 1942 to supply the Government's new Hurricane Creek alumina plant, scheduled to start operations in July 1942. Enemy submarine torpedoing of boats carrying bauxite from South America to the United States and Canada resulted in the issuance of Order M-1-h on July 7, 1942, which allocates for any use all bauxite, both domestic and foreign, containing less than 15 percent silica and all alumina, effective August 1, 1942.

Power for the original, first, and second aluminum expansion programs and for other industries presented the Government with a serious problem, and during the first part of 1941 the Office of Production Management set up a special branch to study power requirements. Total power generated in 1941 for public and industrial use is said to have totaled approximately 212,000,000,000 kw.-hr. To supply expanding war industries in 1943, total requirements have been placed as high as 300,000,000,000 kw.-hr. During 1941 many power projects were completed or extended, and construction of new hydroelectric and steam plants was begun. Outstanding projects included those by the United States Department of the Interior agencies in the West (Bonneville, Grand Coulee, and Boulder Dams)[22] and the Tennessee Valley Authority in the South.[23] Other power expedients were adopted, such as connecting transmission lines or grid systems, power poolings, curtailment of nonessential uses, and the operation of reserve generating capacity in industrial and big city areas. An unprecedented drought in the South during 1941 brought out a call for voluntary reduction in the consumption of power during the summer and early fall. The Federal Power Commission directed immediate construction of connecting power links. Heavy rains late in the fall of 1941, however, relieved the power situation in the South.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

Aluminum is expected to play a leading role in winning the present world conflict. By the end of 1943 production and consumption of both aluminum and magnesium will reach a rate undreamed of before the war. After peace is restored it is expected that a substantial part of the vast productive capacity for these two light metals will be utilized at the expense of other metals because of their greater relative

[22] Bloch, Ivan, Western Power Production and Mineral Development: Paper presented at 8th Ann. Convention, Am. Min. Cong., San Francisco, September 30, 1941, 23 pp.

[23] Parker, Theodore B., Emergency Program of the T. V. A.: Eng. News-Record, vol. 127, No. 25, December 18, 1941, pp. 866-870.

Engineering News-Record, T. V. A. Rushes Power for National Defense: Vol. 126, No. 9, February 27, 1941, pp. 332-335.

abundance in the earth's crust, their utility and diversified usage, and a more advantageous price position (already competitively stronger upon a volume basis).[24]

World production of bauxite is estimated to have reached approximately 6,396,900 metric tons in 1941, 36 percent more than that in 1940 and 66 percent more than that in the pre-war year 1938.

World production of bauxite, 1937–41, by countries, in metric tons

[Compiled by B. B Waldbauer]

Country	1937	1938	1939	1940	1941
Australia:					
New South Wales	6,793	442	(1)	(1)	(1)
Victoria	1,097	1,341	820	[2] 1,000	[2] 1,000
Brazil (exports)	8,770	12,928	18,279	82	14,365
Czechoslovakia	846	(1)	(1)	(1)	(1)
France	688,200	682,440	[2] 800,000	[2] 700,000	[2] 700,000
Germany	18,212	19,703	[2] 20,000	[2] 20,000	[2] 25,000
Greece	137,412	179,886	186,906	[2] 50,000	[2] 50,000
Guiana:					
British	305,533	382,409	483,653	[2] 700,000	1,089,333
Netherlands (Surinam)	392,447	377,213	511,619	615,434	1,198,900
Hungary	532,657	540,718	485,000	[2] 647,000	[2] 1,000,000
India, British	15,393	15,005	9,121	[2] 15,000	[2] [illegible] 000
Indochina	7,000	160	330	118	[2] [illegible],000
Italy	386,495	360,837	483,965	[2] 530,000	[2] 600,000
Netherlands Indies	198,970	245,354	230,668	274,345	171,821
Portuguese East Africa			180	1,030	[2] 1,000
Rumania	10,701	11,807	10,460	[2] 40,000	[2] 40,000
Southern Rhodesia					[2] 1,000
Unfederated Malay States: Johore	19,305	55,965	93,737	63,787	20,000
U. S. S. R.	[2] 230,000	[2] 250,000	[2] 270,000	[2] 300,000	[2] 250,000
United States (dried-bauxite equivalent)	431,898	315,906	381,331	445,958	908,525
Yugoslavia	354,233	396,368	318,840	[2] 290,000	[2] 300,000
	3,746,000	3,849,000	[2] 4,306,000	[2] 4,693,800	[2] 6,396,900

[1] Data not available

[2] Estimated production. Estimates for 1939, 1940, and 1941 by the authors.

World production of aluminum, 1937–41, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941
Canada	41,700	66,000	75,000	[1] 100,000	[1] 200,000
France	34,500	45,300	50,000	[1] 50,000	[1] 60,000
Germany	127,200	161,100	[1] 210,000	[1] 240,000	[1] 300,000
Austria	4,400	4,500			
Hungary	1,000	1,500	1,500	[1] 2,800	[1] 5,000
Italy	22,900	25,800	34,200	[1] 40,000	[1] 50,000
Japan	10,000	17,000	23,000	[1] 35,000	[1] 90,000
Norway	23,000	29,000	31,000	[1] 25,000	[1] 35,000
Spain	37	651	[1] 800	271	[1] 700
Sweden	1,800	2,400	2,700	[1] 2,000	[1] 2,500
Switzerland	25,000	27,000	28,000	[1] 31,000	[1] 29,000
U. S. S. R.	37,700	43,800	[1] 73,000	[1] 75,000	[1] 60,000
United Kingdom	19,300	23,300	25,000	[1] 28,000	[1] 35,000
United States	132,800	130,100	148,400	187,100	280,383
Yugoslavia	200	1,200	2,400	[1] 2,800	[1] 3,000
	481,500	578,700	705,000	[1] 819,000	[1] 1,150,600

[1] Estimated production. Estimates for 1939, 1940, and 1941 by the authors.

[24] Tyler, Paul M., Tomorrow's Metals Min. and Met., vol. 23, No. 421, January 1942, pp. 5–8.
Franke, Herbert A., The Future Sources of Aluminum Paper presented at Industrial Minerals Div. Meeting, Am. Inst. Min. and Met. Eng., Rolla, Mo., October 24, 1941, 8 pp.
Anderson, Robert J., The World Aluminum Industry: Mining Mag (London), vols. 64 and 65, Nos. 6 and 1, June and July 1941, pp. 285–292, 15–25.
Armstrong & Co., George S., An Engineering Interpretation of the Economic and Financial Aspects of American Industry: Vol. 3, The Light Metal Industries—Aluminum, Magnesium, New York, 1942, [illegible] pp.

The aluminum made in 1941 is believed to have totaled about 1,150,600 metric tons, 40 percent more than in 1940 and 99 percent more than in 1938. Of the world output in 1941, it is thought that production under the control or domination of Germany in Europe was about 485,200 tons; under total Axis control, 575,200 tons (or 50 percent); and under total Allied control, 575,400 tons (or 50 percent). The annual rate of production in 1943–44 may be about as follows: German European control, 721,000 tons; total Axis control, 921,000 tons (36 percent); and total Allied control,1,620, 000 tons (64 percent).

REVIEW BY COUNTRIES

Australia.—Extensive geological surveys conducted by the Department of Mines reveal the occurrence of substantial reserves of low-grade bauxite and alunite in Australia. New South Wales ore analyzed ranges from 25 to 68 percent Al_2O_3, 2 to 39 percent Fe_2O_3, and up to 20 percent SiO_2. Sulphates Pty., Ltd., now mining bauxite at Boolarra, Victoria, and the White Metals (Australia) Pty., Ltd., are interested in developing various other ore deposits, including those at Ouse, Tasmania (reserves reported at 2,000,000 tons with 48 percent Al_2O_3); Mount Tambourine, Queensland; and Wingello, New South Wales. The Australian Aluminium Co. Pty., Ltd., began to operate its aluminum strip and sheet rolling mill at Granville, New South Wales, on May 1, 1941, and the construction of another fabricating mill in Australia is under consideration. The use of aluminum for other than authorized purposes was prohibited by the Minister of Munitions on December 17, 1941, The National Aluminium Mining & Smelting Co. proposes to produce 5,000 tons of alumina annually at Port Kembla, using bauxite from Wingello, New South Wales, and to locate a reduction plant at Sydney.

Brazil.—Companhia Electro-Chimica Brasileira plans to construct a 10,000-ton alumina and a 2,000-ton reduction plant at Saramenha, a short distance from Ouro Preto, Minas Gerais. A priority rating for equipment has been granted the company in the United States. Bauxite will be obtained from nearby ore deposits, and power will be secured from two hydroelectric plants on the Rio Maynart, one of which is in operation and the other under construction. Companhia Brasileiro de Aluminio, S. A., plans to develop the Poços de Caldas bauxite deposits and to produce aluminum at plants to be built near São Paulo, but it now appears likely that the shortage of critical materials in the United States will hinder early completion of this project. The Bank of Brazil, with Government authorization, granted the company a loan repayable within 12 years. The fabrication of aluminum (chiefly cooking utensils) in São Paulo was paralyzed in the summer of 1941 as importation of the metal from the United States virtually ceased. Exports of bauxite from Brazil in 1941 (chiefly to the United States) totaled 14,365 metric tons compared with only 82 tons in 1940.

British Guiana.—Exports of bauxite by the Demerara Bauxite Co., Ltd., during 1941 totaled 1,072,617 long tons, of which 908,125 tons went to Canada, 112,815 to the United States, and 51,677 to the United Kingdom. The company had five rotary drying kilns in operation at MacKenzie during the summer of 1941 producing 4,800 tons of dried ore daily. The Berbice Co., Ltd., plans to start shipping

bauxite in the summer of 1942 from its property about 130 miles up the Berbice River. Dried ore is to be barged down to Everton, whence it will be loaded into ocean-going vessels. Establishment of an alumina and aluminum plant in British Guiana has been proposed by American interests.

Canada.—Compared with 1941, Canadian aluminum production is expected to increase about 60 percent in 1942 and more than double in 1943. A 5-day strike at the Arvida reduction plant of the Aluminum Co. of Canada, Ltd., in July was a serious set-back to output in 1941, as the molten metal in the pots solidified when the power was shut off and caused a production delay of several weeks. Aluminum-fabricating facilities also have been greatly expanded in Canada, principally at Kingston, Ontario, where strong-alloy sheet, extrusions, tubing, and forgings are made, partly for United States consumption. Rolled screw machine and rivet stock is produced at Shawinigan Falls, Quebec, and sheet and castings at Toronto, Ontario.

In 1943 one-sixth of all the electric power of the Dominion will be used to produce aluminum. The Aluminum Co. of Canada, Ltd., is further developing the hydroelectric power resources of the Lake St. John-Chicoutimi district and also is investigating available power resources in Manitoba with a view to constructing a new plant in that Province. In the Lake St. John-Chicoutimi district the company will spend $30,000,000 building a channel from its dam at Chute-á-Caron to the mouth of the Shipshaw River, where a hydroelectric plant is to be constructed capable of generating 820,000 hp. (compared with 265,000 hp. now produced at Chute-á-Caron). The proposed facilities could ultimately be extended to 1,000,000 hp. The American Nepheline Corporation (subsidiary of Ventures, Ltd.) is experimenting on the extraction of alumina, potash, and soda ash by a lime-sinter process from nepheline syenite derived from the Bancroft, Haliburton, and Lakefield areas of Ontario. To reduce the sailing time of ocean-going vessels, late in the summer of 1941 South American bauxite began to be discharged at Portland, Maine, for movement by rail to Arvida. Early in 1942 sinkings by enemy submarines began seriously to affect these bauxite cargoes, and bauxite and alumina were imported from the United States.

France.—French aluminum production is believed to have failed in reaching its objective of 70,000 tons in 1941 because of the lack of railroad transportation, lack of skilled labor, inadequate coal supply, and hydroelectric power and labor troubles. Early in 1942 production was reduced two-thirds owing to power difficulties; these, however, were soon overcome, and production returned to normal in April. Within the next 2 or 3 years the large Genissiat Dam on the Rhône River is expected to be completed, and it will be able to supply an enormous quantity of hydroelectric power. Most of the aluminum is now shipped to Germany or used in France to produce war equipment for Germany. The Groupement de Repartition de la Bauxite was recently founded in France by Pechiney, Ugine, Union des Bauxites, Bauxites de France, Bauxites du Midi, Ciments de Lafarge et du Teil, and Aluminium du Sud-Ouest to undertake the distribution and control the utilization of all bauxite. Axis European production of aluminum depends partly on France, not only for metal but for bauxite and alumina, which are shipped to Germany, Switzerland, Italy, Norway, and other countries for processing. Southern France is reported to be shipping bauxite to Italy at the rate of 250 truckloads daily.

Germany.—German and Austrian aluminum production in 1941 has been estimated at 300,000 to 350,000 tons. Greater production is believed to have been retarded by Germany's lack of hydroelectric power, the heavy demand by other industries for steam power, the lack of miners to extract more coal, bombings by the British Royal Air Force, and inadequate transportation facilities. Although most of the aluminum output is derived from bauxite mined in Hungary, France, and the Balkan countries, two German plants (Lautawerk and Lippe or Lünen) are reported jointly producing 50,000 tons of alumina annually from clay, and two other plants (Lautawerk and Horrem near Cologne, owned by Lurgie Thermie G. m. b. H. of Metallgesellschaft A. G.) are making virtually all of the aluminum-silicon or Silumin alloy (12 percent silicon) needed by direct thermal reduction of clay with carbon.[45] Germany greatly increased its supply of aluminum in its conquest of other European countries, particularly in the acquisition of France and Norway. Three new aluminum plants with a total capacity of 50,000 tons are reported under construction in Austria—two on the Inn River below the Innwerke plant and the third on the Enns River. It is reported unofficially that Germany obtained 38,000 tons of bauxite and 10,000 tons of aluminum from Unoccupied France between January 15 and March 1, 1941. On June 1, 1941, the price of aluminum was reduced from 133 reichsmarks to 127 per 100 kilograms. The import duty on alumina (4 reichsmarks per 100 kilograms) for aluminum production was removed March 1, 1942.

Gold Coast.—A bauxite mine was opened in the Colony about 50 miles northwest of Dunkwa, whence the ore is hauled by truck to Dunkwa and by rail to Takoradi.

Honduras.—Unconfirmed reports mention the occurrence of bauxite in southern Honduras.

Hungary.—The production capacity of aluminum plants owned by Manfried Weiss and the Kohlenbergbau, A. G., was expanded substantially in 1941. The Ungarische Bauxitgruben, A. G., increased its production of bauxite about 50 percent in 1941 over that of 1940 (647,000 tons) and plans to build an alumina (20,000 tons) and aluminum reduction (10,000 tons) works at Ajka, near Veszprem, as well as an aluminum-fabricating plant at Stuhlweissenberg. During the latter part of 1941 the Hungarian Price Commissariat ordered an increase in taxes on 99.3- to 99.5-percent aluminum and on semifinished materials from Pengos 27 to Pengos 49 per 10 pounds. The maximum selling price for raw aluminum, including taxes, was increased from Pengos 280–297 to Pengos 302–310 per 10 pounds.

India, British.—The new 20,000-ton alumina and 3,000-ton reduction plant of the Aluminium Corporation of India, Ltd., at Asansol, Bengal, started operations early in 1941. Indian bauxite is used in the alumina plant, and Söderberg electrodes are employed in the reduction works. The Aluminium Production Co. of India, Ltd., still plans to construct aluminum-producing facilities at Alwaye, North Travancore. The Development Department of the Government of Madras reveals that many million tons of workable bauxite of various grades occur in the Shevaroy Hills about 207 miles southwest of Madras.

[45] Haenni, P. M., Light Alloys in Modern Warfare: Canadian Metals and Met. Ind., vol. 5, No. 2, February 1942, pp. 36–42.

Italy.—According to Giornale d'Italia, the Italian production of aluminum would reach 50,000 metric tons in 1941, 60,000 in 1942, and 100,000 by 1943 and 1944. Production in 1941, by plants, is estimated as follows: Porto Marghera (Venice), 20,000 tons; Bolzano, 15,000 tons; Mori, 10,000 tons; and Borgofranco, 5,000 tons. In May 1941 Trafilerie e Punterie di Cogoleto was authorized to enlarge its Cogoleto fabricating plant. Società Edison (Milan), a power company, received permission to build a reduction plant with an annual capacity of 10,000 tons. Although the aluminum industry is still expanding, the shortage of electric power has caused great difficulties, and Italy exports some of its alumina to Germany in payment for necessary machinery.

Japan.—Few official data on the Japanese aluminum industry have been available since 1937. The conquest of Malaya and the fall of Singapore made available to Japan large reserves of high-grade bauxite on Bintan Island and in Johore, and Japanese industrial concerns are reported to have started immediate development of the deposits. The Aluminium Co. of the South Seas is reported working bauxite deposits on Palao Island, where reserves are reputed to total 10,000,000 tons. Early in 1941 the Japanese Ministry of Industry placed Yen 30,000,000 at the disposal of the aluminum industry for developing bauxite deposits in Northern China and Indochina and on Panope Island. Expansion of the Japanese aluminum industry was urged by the Government in 1937, and by the end of 1941 Japan is believed to have had aluminum-producing facilities totaling about 140,000 to 150,000 metric tons. Aluminum production in 1941 is estimated at 90,000 tons, but some observers place output as high as 150,000 tons. In 1941 the aluminum industry was consolidated further by the Government. The Toyo Aluminium Co., belonging to the Mitsui group, was amalgamated with the Sei-Sen Chemical Co., a subsidiary of the Japan Soda Co.

Following is a list of the principal Japanese aluminum companies, with some of their plant locations and annual capacities (in metric tons):

Company:	*Alumina*	*Aluminum*
Japan Light Metals Co.	Shimizu, Shizuoka Pref. (120,000).	Kambara, Shizuoka Pref (27,000 to 36,000). Niigata, Niigata Pref. (18,000 to 27,000).
Japan Electrochemical Industry Co.	Koyasu, Nagano Pref.	Omachi, Nagano Pref. (20,000).
Japan Aluminium Co.	Takao, Taiwan (20,000).	Takao, Taiwan (10,000). Karenko, Taiwan (2,000 to 6,000).
Manchuria Light Metals Mfg. Co.	Fushun, Manchuria (25,000 to 45,000).	Fushun, Manchuria (12,000). Antung, Manchuria (9,000).
Sumitomo Aluminium Reduction Co.	Niihama, Shikoku Island, Ehime Pref. (18,000).	Kaneko-Mura, Niigun, Shikoku Island; Ehime Pref. (9,000).
Japan Soda Co.	Takaoka, Toyama Pref.	Takaoka, Toyama Pref. (16,000 to 20,000).
Korea Nitrogen Fertilizer Co.	Konan, Chosen	Konan, Chosen (6,000).
Japan-Manchuria Co.	Iwase, Toyama Pref.	Koriyama, Fukushima Pref. (5,000).
Toyo (Oriental) Aluminium Co.	Omuto, Kyushu Island, Fukuoka Pref.	Takaoka, Toyama Pref. (6,000).

Another alumina plant is said to be located at Kurosaki, Kyushu Island.

Netherlands Indies.—The N. V. Billiton Maatschappij produced 171,821 metric tons of bauxite on the Island of Bintan in 1941. Of the 165,571 tons shipped, 130,871 tons went to Japan, 25,000 to Australia, and 9,700 to the United States. Plans for the erection of hydroelectric, alumina, and aluminum plants in Sumatra were delayed in 1941 and later were upset by Japanese occupation of the Indies.

Norway.—A/S Nordag, registered on June 26, 1941, owned by Hansa Leichtmetall A. G., Berlin, and directed by Field Marshal Hermann Goering, has largely completed plans and has started preliminary work on aluminum plants and power stations at Sunndalsoyra, Ose, Tyin, Tyssedal, Sauda, Glomfjord, Eitreheim, and Lassedal. Before the Germans entered the Norwegian aluminum industry the reduction plants had about the following rated capacities: Tyssedal (Hardangerfjord), 6,000 tons; Haugvik (Glomfjord), 8,000; Hoyanger, 9,000; Eydehavn, 10,000; Vigeland, 4,000; and Stangfjord, 1,000. Apparently plans have been made to extend capacity at Glomfjord to 23,000 tons, commencing March 1, 1942; at Eitreheim to 8,000 tons, beginning May 1, 1942; and at Tyin to 22,000 tons, starting September 1, 1942. Alumina amounting to 60,000 tons annually is to be produced at Sauda (Rogalan), and amounting to 50,000 tons at Ordalstangen, Tyin. Work at Ordalstangen is scheduled to start July 1, 1942. Plans for the other sites are not completed. Another company involved in the expansion of Norwegian aluminum production to 130,000 tons annually is Nordisk Lettmetal A/S, controlled by I. G. Farbenindustrie. One of its reduction works will be at Skienfjord, in the neighborhood of the Norsk Hydro power installation at Heroya. This plant, however, will be supplied with power from a new hydroelectric plant to be built at Rjukan. The Norwegian Nitrogen Co. is said to be working in conjunction with the German concerns. Apparently the alumina is to be derived from bauxite obtained by rail and boat from Unoccupied France, Hungary, Yugoslavia, and Greece and from domestic labradorite.

Southern Rhodesia.—The manufacture of aluminum sulfate in South Africa by African Explosives & Industries, Ltd., was made possible by the discovery of a high-grade deposit of bauxite near Penhalonga, Southern Rhodesia.[26] The deposit is operated by the Wankie Colliery Co., Ltd., which experimented with the ore but found it unsuitable for the manufacture of refractory brick. A 5-year contract was then signed for supplying the Umbogintuini and Modderfontein chemical plants of African Explosives & Industries, Ltd. The ore in most places is overlain by not more than 20 feet of overburden and is worked by open-cut methods. From the drying plant the ore is bagged and shipped to Umtali whence it must be transported by truck, oxen, and wagon. The ore averages about 62 percent Al_2O_3, 6 percent SiO_2, 1 percent Fe_2O_3, 8 percent insolubles, and 1 percent moisture.

Spain.—Owing to the shortage of copper in Spain, aluminum production is to be increased and domestic bauxite deposits will be exploited. Mining has been carried on at intervals at Gijon, Asturias, and in the southwestern part of Barcelona, but the ore has heretofore been considered too low in grade and unsuitable for metallurgical

[26] South African Mining and Engineering Journal, The Penhalonga Bauxite Deposit: Vol. 52, No. 25 August 16, 1941, pp. 739–742.

purposes. A second aluminum reduction plant, of 8,000 tons annual capacity, is being built and eventually will operate on domestic raw material. The old reduction works at Sabinanigo is producing at a rate of 700 to 1,200 tons of aluminum annually.

Surinam.—Virtually all of the 1,180,000 long tons of bauxite exported from Surinam (Netherlands Guiana) in 1941 by the Surinaamsche Bauxite Maatschappij (subsidiary of Aluminum Co. of America) went to the United States. American troops occupied Surinam in November 1941, partly to protect the valuable bauxite deposits developed in the Moengo and Para Creek districts. N. V. Billiton Maatschappij has completed most of its mining installations and plans to ship bauxite from its deposits in the Para Creek district (near Paranam) to the Reynolds Metals Co. in the summer of 1942. The bauxite reserves of Surinam are reported adequate to last many years, and visible ore reserves of the Moengo Hill and Rorak regions alone have been estimated at 10,000,000 tons and 8,000,000 tons, respectively (ranging from 54 to 64 percent in Al_2O_3 content).

Sweden.—During the first half of 1941, Sweden was able to maintain an almost constant stock of aluminum, but in the latter half supplies were cut drastically. As a result, Svenska Aloxidverken A. B., a subsidiary of A. B. Svenska Aluminium Kompaniet, was formed to manage two projected new plants. Construction of a plant at Kubikenborg, near Sundsvall, northern Sweden, capable of producing 6,000 tons of alumina annually from Boliden andalusite, has been started and will be completed in the spring of 1942. A reduction plant is to be built at the same place with an annual capacity of 1,100 tons of metal. This plant will require about 2,000 tons of the locally produced alumina, and the remaining 4,000 tons will be shipped to the Månsbo reduction plant. Restrictions were placed on the use of aluminum in April 1941.

U. S. S. R.—Two of the three Soviet aluminum reduction plants (Dnepr with 35,000 tons capacity and Volkhov with 15,000 tons capacity) probably were destroyed before Germany invaded or attacked these two areas. Equipment from the Dnepr plant is believed to have been moved to the Kamensk or to another plant site in the Urals. The previously announced annual capacity of the Kamensk works was 50,000 tons.

United Kingdom.—Although small additional aluminum-producing facilities have been completed, the United Kingdom depends largely on Canada for its metal requirements.

Yugoslavia.—Output of bauxite in Croatia totaled 211,000 metric tons in 1941 compared with 271,000 tons in 1940. Croatia now possesses most of the Dalmatian-Hercegovinian mines, but the alumina and aluminum works at Lozovac are in Italian hands. Italy concluded an agreement with Croatia whereby the aluminum works at Lozovac will deliver a large part of its metal output to Croatia in return for bauxite. Construction of a 30,000-ton aluminum plant in Croatia is under consideration. A new bauxite deposit has been discovered near Brijeg in Slovakia.

MERCURY

By H. M. Meyer and A. W. Mitchell [1]

SUMMARY OUTLINE

SUMMARY

The Axis Powers were favored with supplies of mercury at the outset of the present World War, because Italy and Spain, the principal world sources, were closely associated with them. The development of alternate sources of supply to cover their requirements, therefore, was a problem their opponents had to solve. Since the war began, however, production in Western Hemisphere countries has increased until, for a time at least, the United Nations are relatively self-sufficient in this commodity for all essential purposes. There can be little question that the record-breaking high prices for mercury played their part in this outstanding achievement.

In 1939 the United States produced 18,633 flasks, Mexico 7,376 flasks, and Canada 6 flasks. By 1941 the production in the United States had reached 44,921 flasks and in Mexico 23,137 flasks. Data for Canada cannot be published, but it is well-known that a noteworthy contributor to world supplies has been developed and is producing large quantities.

Consumption in the United States during 1941 was 67 percent above that in 1940 and indicated that a new high record rate was established. The sharp upward trend in domestic production during 1940 continued in 1941 with diminished vigor; supplies from United States mines just sufficed to satisfy increased domestic needs but allowed no surplus for exportation. Export restrictions imposed in 1940 were effective in preventing needed metal from leaving the country, and an agreement reached in July 1941 assured retention of Mexican production in the Western Hemisphere. At the end of the year, supplies and requirements appeared to balance, with some metal available for stock-piling. Nevertheless, the probability of increased demands for war purposes led the Office of Production Management to consider means of reducing consumption of mercury in uses designated as nonessential.

[1] Monthly data on production, consumption, and stocks compiled by D. A. Wyatt.

These considerations eventuated in Conservation Order M-78, issued in January 1942 and discussed in more detail later in this report.

Domestic production of mercury amounted to 44,921 flasks in 1941 and was 19 percent above the total for 1940, which itself was more than double the rate that had obtained for a number of years immediately preceding. The 1940 and 1941 totals represent successive peaks in the annual production recorded since 1883.

General imports of mercury totaled 7,478 flasks in 1941 compared with 1,861 flasks in 1940; of the 1941 total, none was entered in the first 7 months, 750 flasks in August, 735 in September, none in October, 1,725 in November, and 4,268 in December. Immediately after the agreement with Mexico in July 1941, exports and production figures for that country dropped sharply. By the end of 1941, however, imports into the United States were exceeding the monthly rate of production in Mexico, indicating that any accumulated stocks in that country may have been in process of dissolution.

Exports dropped from 9,617 flasks in 1940 to 2,590 flasks in 1941, under the restrictions placed thereon in July 1940. The United Kingdom was the principal destination of mercury exported from the United States in both 1940 and 1941 but in 1941 took only a small fraction of the total taken in 1940– 598 flasks compared with 5,178 flasks. Japan received no mercury from the United States in 1941 compared with 1,598 flasks in 1940. It is significant that late in 1941 the United States received 210 flasks of mercury from Canada, now the only source of consequence in the British Empire, but shipped reduced quantities to the United Kingdom. This condition lends weight to the suggestion that the British need mercury products more seriously than they do the metal itself.

Despite the sharp upturn in domestic mercury consumption, the average quoted price in 1941 advanced somewhat less than 5 percent over that in 1940. The 1940 average had been the highest on record, but a new record was established in 1941. Further price gains in 1941 were discouraged by warnings issued twice during the year by the Office of Price Administration. Although the first warning was in March 1941, action with regard to the establishment of a price ceiling was delayed until February 1942. When action was taken, ample supplies for all foreseeable war needs were believed by the price agency to have been provided for and not to have been endangered by the price move

Salient statistics of the mercury industry in the United States, 1937–41

[Flasks of 76 pounds]

	1937	1938	1939	1940	1941
Production ... flasks	16,508	17,991	18,633	37,777	44,921
Number of producing mines	101	91	107	159	197
Average price per flask:					
New York	$90.18	$75.47	$103.91	$176.87	$185.02
London	$69.65	$66.92	$88.26	$201.10	$194.20
Imports for consumption:					
Pounds	1,437,712	179,522	265,944	12,971	588,228
Equivalent flasks	18,917	2,362	3,499	171	7,740
Exports:					
Pounds	34,485	54,161	91,780	730,877	196,837
Equivalent flasks	451	713	1,208	9,617	2,590
Apparent new supply ... flasks	35,000	19,600	20,900	[1] [2] 26,800	[1] 44,800

[1] Actual consumption as reported by consumers. [2] Revised figures.

Agreement with Mexican Government.—During July 1941 an agreement was reached with the Mexican Government whereby the United States was to obtain surplus production of certain materials, including mercury, for 18 months. Under the terms of the agreement, the United States was obliged to acquire all metal not sold through ordinary commercial channels in countries in the Western Hemisphere that had export restrictions similar to those that had recently been put into effect in Mexico; the obligation applied to quantities up to 125 percent of total exports of mercury from Mexico during the 18 months ended July 1, 1941. Purchases are being made for the United States by the Metals Reserve Co. The agreement provides for changing prices based upon quotations in the United States regarded by the United States Government as technically authoritative.

This agreement not only guaranteed the United States large additional supplies of strategic commodities but denied these commodities to an enemy country. Japan received 93 percent of all the mercury shipped from Mexico in the first 7 months of 1941, before the agreement was signed, but received none officially after August.

Import restrictions.—General Import Order M-63, which went into effect at 12:01 a. m., December 28, 1941, provides that unless otherwise authorized by the Office of Production Management (now War Production Board) all future contracts for imports of 13 strategic materials, including mercury, will be handled by the Metals Reserve Co. An amendment issued in 1942 added mercury-bearing ores and concentrates to the commodities covered by the order.

Conservation in use.—The need to provide enough mercury for all possible war uses led the Office of Production Management to study the problem of reducing or discontinuing consumption of mercury in uses considered nonessential. Its study resulted in Conservation Order M-78, issued January 23, 1942. This order restricted the use of mercury for carroting hat fur, for marine antifouling paint, thermometers (except industrial and scientific), treatment of green lumber (except Sitka spruce), turf fungicides, vermilion, wall switches for nonindustrial use, and wood preservatives from January 15 to March 31 to 50 percent of such use in a selected base period, described later. Beginning April 1, 1942, all use for the purposes mentioned was to be discontinued, unless otherwise specifically authorized by the Director of Priorities. Consumers of mercury for the following purposes were ordered to restrict their use to the percentages given, as follows: Fluorescent lamps, 100 percent; health supplies, 100; mercuric fulminate for commercial blasting caps, 125; mercuric fulminate for ammunition, 100; and thermometers (industrial and scientific), 100 percent. Other consumers were restricted to 80 percent. "Base period" meant, at the option of the manufacturer, either (1) the corresponding quarterly period in 1940 or (2) the first calendar quarter of 1941, provided that the same option should be used throughout the calendar year. Exceptions from the order primarily covered materials for delivery under war and Lend-Lease contracts.

Price control.—The price for mercury was subjected to ceiling limitations in February 1942, following a prolonged study during which there was official warning more than once that the price was too high. Price Schedule 93 of the Office of Price Administration provided that the maximum base price for California, Oregon, Washington, Idaho, Utah, Nevada, or Arizona was \$191 per 76-pound flask, f. o. b. point

of shipment; for Texas and Arkansas it was $193, f. o. b. point of shipment; for mercury produced outside the continental United States and Mexico and entering the United States through Pacific coast ports of entry, it was $191, and for Mexico it was $193, f. o. b. freight station in the United States at or nearest the point on the boundary at which the shipment enters the United States (duty, if any, included).

Other sections of the order placed limitations on the dealers', brokers', and agents' charges.

Stock-pile purchases.—Mercury produced in the United States was added to the stock pile of the Procurement Division of the Treasury Department in 1941. In the latter part of the year, metal from Mexico began to accumulate for the credit of the Metals Reserve Co. Stock-pile gains in 1942 will comprise metal obtained from other Western Hemisphere sources, as well as from domestic mines and Mexico.

Bureau of Mines and Geological Survey activities.—The Bureau of Mines explored mercury deposits in six scattered districts in Oregon that revealed about 150,000 tons of low-grade ore averaging 1.6 pounds of mercury per ton. In addition, 200,000 tons of possible ore of similar grade may be expected upon the basis of reasonable geological deductions. Low-grade deposits in California were explored by test pitting and rotary bucket, which outlined over 100,000 tons of ore averaging 1.6 pounds per ton. In Valley County, Idaho, diamond drilling has indicated over 400,000 tons averaging 2.7 pounds of mercury per ton, and very recently one diamond-drill hole penetrated 34 feet (24 feet, true thickness) averaging over 11 pounds of mercury per ton. The importance of the higher-grade strike cannot be gaged until surrounding holes have been drilled. Exploration has been started on the old mine at Black Butte, Oreg., in the hope that the virtually depleted reserves there might be augmented. Drilling along the New Idria fault was begun late in 1941. This drilling is in the nature of wildcatting upon the basis of geological evidence.

The Bureau's engineers investigated seven additional mercury deposits in Nevada, California, Idaho, and Oregon, which (it has been estimated) might contain 850,000 tons of ore averaging 2.3 pounds of mercury per ton. This estimate, of course, is speculative and will have to be verified by further exploration.

During 1941 the Geological Survey issued reports on the mercury deposits of San Luis Obispo County and southwestern Monterey County, Calif.;[2] Steens and Pueblo Mountains, southern Oregon;[3] and adjacent parts of Nevada, California, and Oregon.[4] Field work was completed and reports were in preparation on the Pike County (Ark.) district; the Opalite district, Malheur County, Oreg., and Humboldt County, Nev.; the Weiser district, southwestern Idaho; and the Morton district, Lewis County, Wash. In Nevada, field work also was completed in the Wildhorse district, Lander County, and the Antelope Springs district, Pershing County; and work was in progress in the Ivanhoe and Mount Tobin districts in Elko and Pershing Counties, respectively. In addition, several smaller districts and scattered prospects in Nevada were examined and mapped

[2] Eckel, E. B., Yates, R. G., and Granger, A. E., Quicksilver Deposits in San Luis Obispo County and Southwestern Monterey County, Calif.: Geol. Survey Bull. 922-R, 1941, pp. 515-580.

[3] Ross, C. P., Quicksilver Deposits in the Steens and Pueblo Mountains, Southern Oregon: Geol. Survey Bull. 931-J, 1941, pp. 227-258.

[4] Ross, C. P., Some Quicksilver Prospects in Adjacent Parts of Nevada, California, and Oregon: Geol. Survey Bull. 931-B, 1941, pp. 23-37.

in cooperation with the Bureau of Mines in a comprehensive sampling project, which was continued into 1942. In California, field work was completed in eight separate areas: The Coso district, Inyo County; New Idria district, San Benito County; Stayton district, San Benito and Merced Counties; Parkfield district, Monterey County; Knoxville district, Napa, Yolo, and Lake Counties; southeastern Mayacmas district, Napa and Lake Counties; Panoche district, San Benito County; and Canon del Puerto (Phoenix) district, Stanislaus County. Some preliminary work was done in the New Almaden district, Santa Clara County, and many small deposits and prospects throughout the State were visited in a search for promising areas in which to do additional work as well as to bring earlier information up to date. At the end of the year, field work was in progress in California in the northwestern part of the Mayacmas district, Lake and Colusa Counties, and in the Patricks Creek district, Del Norte County. In the New Idria district, an exploratory drilling program was begun by the Bureau of Mines, with geologic guidance by the Geological Survey.

In southwestern Alaska, field work was completed on the mercury deposits of Sleitmut in the Georgetown district.

In Mexico, work was in progress on cinnabar-bearing placers near Guadalcazar in San Luis Potosi, and early in 1942 a detailed study was begun in the new mercury area near Fresnillo, Zacatecas.

The Bureau of Mines recently issued two publications [5] that discuss hazards in mercury mining.

PRICES

Quoted prices for mercury trended upward throughout 1941 and twice during the year were the target of warnings issued by the Office of Price Administration. The average monthly price in New York was $165.85 a flask in January 1941 and $199.65 in December. Only in 2 previous months—January and February 1916—had monthly average prices been higher than in December 1941; and the annual average of $185.02 for 1941 had never been exceeded. Despite the fact that prices had advanced from $84.41 in August 1939—the month before declaration of war in Europe—and the threats mentioned above, price-ceiling action was withheld until February 1942. Probably the delay was due to the hesitancy of the price agency to take any action that might seriously disturb the maintenance of a favorable balance between supplies and requirements for this metal. By the time action was taken, substantial quantities of new supplies were arriving from Mexico, and steps to conserve the use of mercury had been taken by the Office of Production Management.

Early in 1940 the cartel price for Italian and Spanish mercury was $200 a flask, f. o. b. ports of origin; it advanced to $250 a flask in December, where it remained throughout 1941.

The price for mercury in London was £48 a bottle (flask) in January 1941. In May a new control order was issued which called for maximum prices of £48 15s. a bottle for quantities of over 1 and less than 11 bottles and of £48 for larger quantities, ex-sellers' premises in both cases. Smaller lots and redistilled grades were entitled to higher prices. The Ministry of Supply also announced that it was

[5] Davenport, Sara J., and Harrington, D., Mercury Poisoning as a Mining Hazard: Bureau of Mines Inf. Circ. 7180, 1941, 27 pp.
Randall, Merle, and Humphrey, H. B., New Process for Controlling Mercury Vapor: Bureau of Mines Inf. Circ. 7206, 1942, 10 pp.

prepared to sell mercury to approved buyers at £47 15s., ex-warehouse in the United Kingdom

Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of New York price over London price, 1939–41

Month	1939			1940			1941		
	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London
January	$77.44	$70.97	$6.47	$156.96	$169.50	[3] $12.54	$165.85	$193.64	[3] $27.79
February	85.23	75.21	10.02	178.00	207.00	[3] 29.00	170.18	193.43	[3] 23.25
March	87.28	77.81	9.47	180.92	207.00	[3] 26.08	177.69	193.53	[3] 15.84
April	90.80	82.40	8.40	173.54	181.32	[3] 7.78	180.08	193.19	[3] 13.11
May	86.77	79.87	6.90	181.54	168.34	13.20	180.00	194.50	[3] 14.50
June	86.62	76.09	10.53	197.36	189.44	7.92	183.92	194.52	[3] 10.60
July	86.96	76.21	10.75	194.42	207.36	[3] 12.94	188.58	194.56	[3] 5.98
August	84.41	76.08	8.33	184.11	216.84	[3] 32.73	192.00	194.53	[3] 2.53
September	140.00	90.78	49.22	173.33	219.86	[3] 46.53	192.44	194.58	[3] 2.14
October	145.60	108.00	37.60	168.85	219.78	[3] 50.93	193.62	194.59	[3] .97
November	134.98	109.75	25.23	168.39	219.94	[3] 51.55	196.27	194.65	1.62
December	141.20	136.00	5.20	164.96	206.79	[3] 41.83	199.65	194.69	4.96
Average	103.94	88.26	15.68	176.87	201.10	[3] 24.23	185.02	194.20	[3] 9.18

[1] Engineering and Mining Journal, New York

[2] Mining Journal (London) prices in terms of pounds sterling converted to American money by using average rates of exchange recorded by the Federal Reserve Board, through August 1939 and from April 1940 to the end of that year, during the intervening period prices were quoted in American money. Official prices, established early in May 1941, were £47 15s to £48 15s. per flask beyond the end of the year.

[3] London excess.

CONSUMPTION

The Bureau of Mines began to compile monthly data on consumption of mercury at the outset of the present World War—September 1939. Before that time, supplies of metal available for use were calculated by the conventional method of merely adding production to imports and deducting exports, if no stock figures were available. Figures for 5 years are shown in the following table, in which apparent new supply figures are given for 1937 to 1939 and consumption data for 1940 and 1941.

There seems little reason to question the indication that in 1941 mercury was consumed at a new high-record level. During the period of highest domestic production, 1877 and the years immediately preceding and succeeding, metal also was exported at a very high rate. Export figures before 1880, however, are not entirely satisfactory, and precise comparisons are impossible.

Supply of mercury in the United States, 1937–41, in flasks of 76 pounds

Year	Production	Imports for consumption	Exports	Apparent total new supply
1937	16,508	18,917	454	35,000
1938	17,991	2,362	713	19,600
1939	18,633	3,499	1,208	20,900
1940	37,777	171	9,617	[1, 2] 26,800
1941	44,921	7,740	2,590	[1] 44,800

[1] Actual consumption as reported by consumers. [2] Revised figures.

Requests for consumption data were revised in the middle of 1941 in order to obtain more detailed figures. Statistics for the first and second halves of the year, as reported to the Bureau of Mines, follow.

Mercury consumed in the United States in 1941, in flasks of 76 pounds

JANUARY TO JUNE

Use	Flasks	Use	Flasks
Drugs and chemicals	13,558	Felt manufacture	683
Fulminate	939	Other	1,131
Electrical apparatus	2,317		
Industrial and control instruments	1,456	Total	[1] 21,600
Vermilion	712		

JULY TO DECEMBER

Use	Flasks	Use	Flasks
Pharmaceuticals	2,679	As a catalyst or in electrolytic preparation of—	
Dental preparations	609		
Chemical preparations [2]	4,059	Chlorine and caustic soda	155
Agriculture	1,968	Acetic acid	825
Fulminate	1,601	Other	1,202
Electrical apparatus	2,379	Amalgamation	225
Industrial and control instruments	2,175	General laboratory use	175
Vermilion	510	Redistilled [3]	2,163
Antifouling paint	680	Other	654
Felt manufacture	493	Total	[1] 23,200

[1] Items are upon a partial coverage basis and do not add to total, which has been increased to cover total consumption.
[2] Largely for munitions other than fulminate.
[3] Use of virgin metal in the preparation of redistilled. The breaking down of this quantity would add substantially to industrial and control instruments and lesser amounts to dental preparations, electrical apparatus, and laboratory, pharmaceutical, and other uses.

STOCKS

Inventories of mercury in the hands of consumers and dealers amounted to about 12,400 flasks at the end of 1941 compared with 14,100 flasks at the end of 1940. These stocks do not include metal held by the Metals Reserve Co. and the Procurement Division of the Treasury Department and are largely exclusive of metal in the hands of companies that consume redistilled mercury only. Stocks held by the last group totaled 1,600 flasks at the end of 1941, but data are not available for the end of 1940. Stocks at mines that reported monthly to the Bureau of Mines aggregated 439 flasks compared with 607 flasks at the end of 1940.

REVIEW BY STATES

Production in the United States in 1941 rose 19 percent over that in 1940, which, in turn, was double the output in 1939. Largest percentage gains were made in Texas, Arkansas, and California, with Arizona also advancing. Less metal was recovered in Nevada, Alaska, Idaho, Washington, and Utah. San Benito and Lake Counties, Calif., ranked first and second as mercury-producing counties, followed by Douglas County, Oreg., and Sonoma County, Calif. New Idria and Bonanza were the two largest producing mines. The principal producing mines in 1941 were as follows:

Arizona—Gila County, Ord group; Maricopa County, Pine Mountain mine.
Arkansas—Clark County, Caddo mine; Pike County, Parker Hill and Superior mines.

California—Contra Costa County, Mount Diablo mine; Lake County, Great Western, Mirabel, and Sulphur Bank mines; Napa County, Oat Hill and Knoxville mines; San Benito County, New Idria (including San Carlos) mine; San Luis Obispo County, Oceanic and Klau mines; Santa Barbara County, Falcon (Santa Ynez) mine; Santa Clara County, New Almaden mine and dumps; Sonoma County, Contact, Great Eastern, and Mount Jackson mines; Yolo County, Reed mine.

Idaho—Washington County, Idaho-Almaden mine.

Nevada—Humboldt County, Blue Bird, Blue Can, and Cordero mines; Pershing County, Mount Tobin mine.

Oregon—Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine; Malheur County, Bretz and Opalite mines.

Texas—Brewster County, Chisos and Big Bend mines; Presidio County, Fresno mine.

These 33 mines produced 85 percent of the United States total. The 29 most important mines produced 86 percent of the total in 1940 and 16 produced 88 percent in 1939.

Mercury produced in the United States, 1938–41, by States

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
1938:			
California	52	12,277	$926,545
Nevada	17	336	25,358
Oregon	13	4,610	347,917
Alaska, Arkansas, Texas, and Washington	9	768	57,961
	91	17,991	1,357,781
1939:			
Arkansas	5	304	37,834
California	59	11,127	1,156,540
Nevada	25	828	86,062
Oregon	14	4,592	477,293
Arizona, Idaho, and Texas	4	1,722	178,985
	107	18,633	1,936,714
1940:			
Alaska	1	162	28,653
Arizona	6	740	130,884
Arkansas	10	1,159	204,992
California	70	18,629	3,294,911
Nevada	42	5,924	1,047,778
Oregon	23	9,043	1,599,436
Utah	1	53	9,374
Idaho, Texas, and Washington	6	2,067	365,590
	159	37,777	6,681,618
1941:			
Arizona	5	873	161,522
Arkansas	19	2,012	372,260
California	87	25,714	4,757,604
Nevada	54	4,238	784,115
Oregon	21	9,032	1,671,101
Utah	1	19	3,515
Alaska, Idaho, Texas, and Washington	10	3,033	561,166
	197	44,921	8,311,283

[1] Value calculated at average price at New York.

Alaska.—Mellick & Halverson produced mercury at the Red Devil mine during 1941 in a 1½-ton retort. The retort was idle for the winter, and the operators reported that a 30-ton Allis-Chalmers rotary was on the ground ready for installation. Two small lots of cinnabar were shipped to the United States for treatment.

Arizona.—Increased activity in Arizona carried the 1941 mercury production to a new peak for recent years. The output of 873 flasks was recovered largely at the Pine Mountain mine, Ord group, and Sunflower mine, as in 1940; smaller amounts came from two other operations. Productive operations are believed to have been confined to Gila and Maricopa Counties.

Arkansas.—A record-breaking number of properties took part in the production of an unprecedented quantity of mercury in 1941—19 mines having contributed 2,012 flasks. The mines are in Pike and Clark Counties. Many of the operations were very small, as is indicated by the fact that six mines supplied 1,777 flasks of the 1941

total. Large producers included the Caddo, Gap Ridge, Parker Hill, Superior, Big Six, and U. S. Mercury. The Mid-Continent mine, one of the larger producers in the past, was idle at the end of 1941.

California.—The supremacy of California as a mercury-producing State has never been challenged. It led by a substantial margin again in 1941, with 25,714 flasks, representing 57 percent of the national total.

Sixteen counties contributed the total for the State; chief among them, in order of importance in 1941, were San Benito, Lake, Sonoma, Santa Clara, San Luis Obispo, and Napa. Their output ranged from over 6,000 flasks to somewhat less than 2,000. In these counties, properties that have been supplying large amounts of metal in recent years—New Idria, Sulphur Bank, Mirabel, Great Western, Mount Jackson, New Almaden (mine and dumps), Klau, Oceanic, Oat Hill, and Knoxville—continued to stand out as large contributors. Other well-known mines in these counties that joined the leading producing properties in 1941 are the Great Eastern and Contact. Large producers in other counties include the Mount Diablo mine in Contra Costa County and the Reed in Yolo County.

The Manzarita and Dewey mines in Colusa County were active in 1941. New concentrating equipment was being installed at Manzanita at the end of the year.

In Contra Costa County the Bradley Mining Co. treated 19,201 tons of ore in its 50-ton Gould rotary at the Mount Diablo mine and produced 1,506 flasks of mercury.

Five mines in Fresno County were producing mercury in 1941, but their total was small.

A small output of metal was recovered from dumps in Inyo County and from two mines in Kings County.

Lake County ranked second only to San Benito in production of mercury in the United States during 1941. The Sulphur Bank mine dominated county output; an important amount also came from the Mirabel, followed by the Great Western and Abbott mines, and the Otto, Midway, and three others also were active. At the Sulphur Bank mine, 18,391 tons of ore were mined and treated in a 50-ton rotary kiln and 4,022 flasks of mercury were recovered. The Great Western mine produced 8,148 tons, of which 6,600 were treated in a 20-ton Herreshoff furnace, yielding 356 flasks of metal. The plant was burned and rebuilt in 1941. The mine and plant are described in the January 1941 issue of Compressed Air Magazine. Extensive diamond drilling and the usual drifting and cross-cutting were reported at the Mirabel mine. Plans were made during the year for reopening the Helen and Red Elephant mines; a new 3- by 40-foot Gould rotary furnace has been installed at the latter.

Activity at the Red Hawk mine in Modoc County resulted in the output of a very small quantity of mercury before the lease was abandoned.

A small quantity of metal was produced at the G. W. D. mine, Monterey County, in 1941.

The Oat Hill, Knoxville, Oat Hill Extension, and Aetna mines all old, familiar names, ranked above other producing properties in Napa County in 1941. The only output from the Knoxville mine in 1940 was from dumps. The Oat Hill treated 24,537 tons of ore in an 80-ton Gould rotary furnace in 1941 and produced 1,044 flasks of mercury,

and the Knoxville treated 1,126 tons of ore and 7,190 tons of dump material in a 40-ton Gould rotary to recover 69 and 389 flasks, respectively. Zack Anderson milled 2,400 tons of ore and recovered 147 flasks in retorts. Aetna's production was made in a 50-ton rotary furnace. Other producing properties included the Toyon, Corona, Manhattan, Twin Peaks, Washington dumps, and several operations on James Creek. Late in 1941 or early in 1942 the Corona mine passed under control of the Twin Peaks Mining Co., which planned to develop a larger-tonnage operation there. This company reported installation of a 70-ton rotary kiln and Diesel electric plant at the Twin Peaks mine in 1941. The Aetna Extension mine, lying between the Oat Hill and Aetna, was taken over by Atkins, Kroll & Co., and production early in 1942 was anticipated. Equipping and development of the Bella Oakes mine were begun in January 1942, and production was scheduled to start 2 months later.

San Benito County led all other counties in the United States in mercury production in 1941. The New Idria mine, as usual, outranked by an enormous margin all other mines in the county and easily led all others in the State, maintaining its place as one of the two leading producers in the country. The Aurora, Wonder, Star Nos. 1 and 2, Stayton, Lea-Grant, Yturriarte, Loneoak, Panoche (Valley View), El Rey, and Clear Creek (including Andy Johnson and Fourth of July) mines also were productive in 1941. The Lea-Grant mine (Lily Berg, Goodall Estate, and Ortiz properties) produced 194 flasks in 1941 from 3,804 tons of ore treated in its new 60-ton Gould rotary furnace.

The Klau mine was the outstanding producer in San Luis Obispo County, with a yield of 1,358 flasks from 14,047 tons of ore mined and treated; a new 70-ton Gould rotary furnace was installed in 1941 to supplement the 40-ton plant already in operation there, and a new shaft was being sunk to the 500-foot level. The Oceanic mine was second in importance; other producers were the Deer Trail, Little Bonanza, Buena Vista (Mahoney), Polar Star, Rinconada, and La Libertad.

Almost all of the output of Santa Barbara County came from the Red Rock and Falcon (Santa Ynez) mines. There are three rotary furnaces at the Falcon property, two of 30 tons capacity each and one of 50 tons. A newly installed Gould rotary was put into operation at the Red Rock mine. Press reports indicated that this plant was moved to California from the Blue Can mine in Humboldt County, Nev.

Activity at the famous New Almaden mine overshadowed all other operations in Santa Clara County during 1941; independent operations on the New Almaden dumps produced considerable metal. Other producers included the Guadalupe mine and several smaller operations.

The only mercury property known to have produced in Siskiyou County during 1941 is the Great Northern, where output was made in a new 50-ton Nichols Herreshoff furnace.

The rise of Sonoma County to third place among the mercury-producing counties in 1941 was due largely to reopening of the Mount Jackson mine in 1940 and of the Great Eastern in 1941 and to increased production at the Contact. Development of the Great Eastern mine included installation of a new 100-ton Gould rotary furnace. This plant treated 13,528 tons of ore and recovered 503 flasks of mercury, and the 75-ton Mount Jackson plant treated 29,068 tons and produced

1,625 flasks. Outstanding among the other producing mines were the Cloverdale, Culver-Baer, and Star Springs. The Socrates, Prospect, and seven other properties yielded the remainder of the county output.

The Altoona and Shasta Lily mines were the only known producers in Trinity County during 1941. Altoona's output is made in a 50-ton rotary.

A 50-ton rotary furnace was reported under construction at the end of 1941 at the Adobe mine in Stanislaus County.

The Bradley Mining Co. produced and treated 3,145 tons of ore to recover 784 flasks of mercury at the Reed mine in Yolo County. A 10-ton rotary was in operation during 1941, and a new 50-ton plant was expected to be completed in February 1942. Some mercury was produced from dump material at the Harrison.

Idaho.—Considerable exploratory work was carried on in Idaho during 1941, and two or three properties were reported to be on the verge of production at the close of the year. The Idaho-Almaden mine near Weiser was the only producing property, however, as in 1940 and 1939. A new Gould rotary of 100 tons rated capacity was installed at the Hermes mine in the Yellow Pine district, Valley County, by Bonanza Mines, Inc.; this property was obtained from the United Mercury Mines Co.

Nevada.—Production of mercury fell from 5,924 flasks in 1940 to 4,238 flasks in 1941 but continued well above the levels of other recent years. The decline was due largely to lowered rates of output in Humboldt and Mineral Counties, explained (in part, at least) by exhaustion of known ore reserves.

The Wild Horse mine in Churchill County was again productive; it yielded 106 flasks in 1941 from the treatment of 945 tons of ore. All operations were suspended in September, however, and no further production was reported contemplated; the Gould rotary furnace was removed.

Five mines in Elko County produced in 1941; the Butte (Bowers-Rand) had the largest output.

More metal was produced at the Red Rock than at any other mine in Esmeralda County. Ore from the Container was treated in the furnace at Red Rock. Two small properties also contributed to the county total.

Mercury output in Humboldt County dropped from the large quantity (2,713 flasks) produced in 1940 to 2,226 flasks in 1941. The largest contributor in 1941 was the Cordero mine, a newly developed property that began to treat ore in a newly installed 100-ton Nichols Herreshoff furnace in August. The output from this mine helped to offset a lowered rate of production in 1941 at some of the larger 1940 mines. As a whole the Blue Can, Blue Bird, and Wootan & McCown mines, operated by McAdoo interests, led Cordero by a considerable margin. Chief among the other producing mines were the Red Ore, Cahill, and Blue Bucket (Baldwin).

Eleven mines in Mineral County reported production; by far the largest part came from the Mina Development Co. property.

Six mines in Nye County were active during 1941. Magee Mercury, Inc., which is operating the Great Eastern mine in Sonoma County, Calif., began to develop the Horse Canyon mine and installed a 25-ton Gould rotary furnace purported to have come from the Wild

Horse mine in Churchill County. Ore from the San Pedro mine was shipped for treatment to the Red Rock mine in Esmeralda County. The Van Ness and three others also produced.

Mount Tobin dominated production in Pershing County. This property produced 6,684 tons of ore that yielded 626 flasks of mercury. In February 1942 the mine was reported worked out, and production was discontinued. The El Dorado mine produced 100 flasks in a Rossi retort during 1941 but was reported as closed on November 28. The Goldbanks mine also made an output and at the end of the year was under lease to the Bradley interests. Five other mines, including the Red Bird, were productive. Considerable activity that did not result in output during 1941 was reported at other properties; these include the old Pershing mine that last produced in 1930.

Oregon.—Oregon's total output of mercury in 1941 was within a few flasks of its 1940 production and double that in 1939. The Bonanza mine, Douglas County, again towered above other producers; the Horse Heaven in Jefferson County and the Bradley properties (Bretz and Opalite) in Malheur County also made important contributions to the total.

The Oak Grove and D. E. Kiggens properties in Clackamas County produced small amounts in 1941.

Nine properties were engaged in productive activity in Crook County; the Taylor Ranch (Whiting) and Staley and Culbertson ranked highest.

As already stated the Bonanza mine, Douglas County, was the dominant producer in Oregon and one of the two largest in the country. It was the only producing mine in the county.

Three properties in the Steens Mountain district, Harney County, reported an output for 1941. For many years this area has been known to contain mercury, but it did not produce until 1939. It has been described by Ross.[6]

The Roxana Group in Jackson County recovered a small quantity of metal in 1941.

The Horse Heaven mine in Jefferson County is the second-largest producer in Oregon. The Axehandle mine in this county also produced in 1941.

A little mercury was produced at the Lucky Boy No. 1 mine in Lake County in 1941.

At the old Black Butte mine in Lane County 19,733 tons of ore were treated, yielding 292 flasks of mercury, in 1941. This mine has had a long record of production and its locality is one of those picked for Bureau of Mines exploration work.

The only output in Malheur County during 1941 was from the Bretz and Opalite properties, operated by the Bradley interests. The Opalite mine produced 13,265 tons of ore that yielded 434 flasks of mercury. Bretz ore, totaling 4,862 tons, was hauled to the Opalite 80-ton rotary kiln for treatment and yielded 498 flasks.

Texas.—All the mercury produced in Texas during 1941 came from the Terlingua region, Brewster and Presidio Counties. Producing properties in Brewster County were the Chisos, Rainbow, Big Bend, Texas Almaden, Gard, and Black Mesa; in Presidio County the Fresno was active. The output at all mines except the Gard was from furnace operations.

[6] Ross, C. P., Work cited in footnote 3.

Utah.—The Congar Hill mine, Tooele County, produced 19 flasks of mercury from 76 tons of ore in 1941.

Washington.—Mercury was produced by the Roy Mining Co. in the Morton district, Lewis County.

FOREIGN TRADE [7]

Imports of mercury for consumption were 7,740 flasks in 1941 compared with the insignificant total of 171 flasks in 1940. Only 104 flasks of the 1941 total were credited to the first 7 months of the year. The benefits of the July agreement with Mexico, discussed elsewhere in this report, did not become evident in import statistics until November. During November and December, imports for consumption aggregated 6,861 flasks, of which Mexico supplied 6,651 flasks; the remainder came from Canada.

General imports, a better measure of the physical movement of imports than imports for consumption, amounted to 7,478 flasks in 1941 compared with 1,861 flasks in 1940.

Mercury imported into the United States, 1937–41, by countries

Country	1937		1938		1939		1940		1941	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Canada									59,633	$130,468
Hong Kong	5	$5					3	$6		
Italy	747,266	649,406	84,454	$50,434	25,528	$29,818	228	316		
Mexico	116,497	104,730			42,745	61,313	9,698	13,681	520,692	1,171,752
Spain	535,156	440,804	95,068	82,176	197,671	245,613	3,042	3,958	7,903	6,373
United Kingdom	38,788	33,046								
	1,437,712	1,227,991	179,522	132,610	265,944	336,744	12,971	17,961	588,228	1,308,593

In addition to the mercury received from Mexico in the form of metal during 1941, antimony-mercury concentrates imported from that country yielded 1,300 flasks during the year. This latter class of imports is not shown separately in foreign trade statistics[8].

Imports of mercury compounds were virtually nonexistent during 1941, as is shown by the table that follows.

Mercury compounds imported for consumption in the United States, 1940–41

Compound	1940		1941	
	Pounds	Value	Pounds	Value
Chloride (mercurous) (calomel)	19,513	$16,374	25	$83
Mercury preparations (not specifically provided for)	21,863	15,362	24	140
Oxide (red precipitate)	9,000	9,234		
Vermilion reds (containing quicksilver)	14,332	13,114	25	9
		54,084		232

Exports fell from the high total of 9,617 flasks reached in 1940 to 2,590 flasks in 1941; the aggregate for 1941, however, was larger than in any other year since 1931. The abnormal relationship of international to domestic prices in 1931 favored exportation of the metal. International prices favored the exportation of mercury again in 1941,

[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

but domestic export restrictions and disruption of international trade routes rendered normal economic laws invalid in that year.

In 1941 little more than one-tenth of the amount shipped to the United Kingdom in 1940 (598 flasks compared with 5,178) was destined to that nation, but it continued to get more than any other country. The shipment of mercury from Canada, the only important source of mercury in the British Empire, to the United States in 1941 would seem to indicate either a relatively adequate supply of metal in the United Kingdom or a greater need for mercury products than for the metal itself. Japan received no mercury from the United States in 1941 but had the second-largest amount in 1940—1,598 flasks. The only sections of the world that received larger quantities in 1941 than in 1940 were the Asiatic Continent and islands (other than Japan), to which 629 flasks were shipped compared with 181 flasks in 1940.

Mercury exported from the United States, 1937–41

Year	Pounds	Value	Year	Pounds	Value
1937	34, 485	$37, 165	1940	730, 877	$1, 743, 149
1938	54, 161	50, 184	1941	196, 837	470, 903
1939	91, 789	137, 427			

Mercury exported from the United States, 1940–41, by countries of destination

Country	1940 Pounds	1940 Value	1941 Pounds	1941 Value
North America:				
Canada	58, 923	$145, 063	10, 905	$29, 604
Curaçao (N. W. I.)	4, 834	10, 264	6, 229	15, 152
Other North America	6, 168	14, 869	4, 057	10, 450
	69, 925	170, 196	21, 191	55, 206
South America:				
Brazil	8, 221	20, 002	5, 324	13, 791
Colombia	12, 512	28, 608	8, 213	20, 257
Other South America	10, 451	26, 380	7, 558	20, 594
	31, 184	74, 990	21, 095	54, 642
Europe:				
United Kingdom	393, 492	970, 533	45, 472	101, 288
Other Europe	7, 170	15, 879	125	465
	400, 662	986, 412	45, 597	101, 753
Asia:				
Hong Kong	6	20	4, 575	11, 588
India, British	1, 612	3, 266	10, 234	22, 685
Japan	121, 466	254, 890		
Netherlands Indies	4, 926	11, 844	21, 882	51, 979
Philippine Islands	5, 117	11, 471	8, 455	20, 966
Other Asia	2, 105	4, 455	2, 632	6, 628
	135, 232	285, 946	47, 778	113, 846
Africa:				
Union of South Africa	30, 266	71, 780	18, 785	45, 128
Other Africa	9, 234	20, 271	5, 656	14, 130
	39, 500	92, 051	24, 441	59, 258
Oceania:				
Australia	50, 648	124, 642	36, 185	84, 305
Other Oceania	3, 726	8, 912	550	1, 893
	54, 374	133, 554	36, 735	86, 198
	730, 877	1, 743, 149	196, 837	470, 903

WORLD PRODUCTION

The inability to obtain data covering activity in Spain and Italy, the world's largest sources of production of mercury, makes it impossible to compile a reliable estimate of world production. As the mines in these areas are either under Axis domination or friendly to the Axis Powers, ample supplies are assured enemies of the United States, whereas supplies for the United Nations have presented more of a problem.

World trade conditions have contributed to greatly expanded production in the United States, Mexico, and Canada during the past 2 years and have prompted prospecting for and development of additional sources in several other Western Hemisphere countries. Output in the United States during 1941 was 44,921 flasks compared with 18,633 in 1939, and Mexico produced 23,137 flasks in 1941 compared with 7,376 in 1939. Canada, during this period, rose from an insignificant producer to a position as the only important source in the British Empire. Interest regarding mercury mining has been reported recently in Honduras, Brazil, Chile, Peru, and Venezuela. In connection with the increased emphasis on finding additional sources of mercury, technical representatives of the United States Government have examined mercury prospects in Mexico and other countries of the Western Hemisphere.

Available information for various countries is reviewed on the following pages.

World production of mercury, 1937–41, by countries

[Compiled by B. B. Waldbauer]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1937		1938		1939		1940		1941	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	140	4.8	191	6.6	(1)	(1)	(1)	(1)	(1)	(1)
Australia: Queensland	9	.3			3	0.1	(1)	(1)	(1)	(1)
Bolivia [2]	16	.6			9	.3	(1)	(1)	(1)	(1)
Canada			10	.3	6	.2	(1)	(1)	(1)	(1)
China	[2] 1,736	[2] 59.8	[2] 65	[2] 2.2	[2] 13	[2] .4	[2] 6,260	[2] 215.8	[3] 6,000	[3] 206.8
Chosen	2	.1	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Czechoslovakia	2,750	94.8	2,900	100.0	[4] 2,669	[4] 92.0	[4] 2,582	[4] 89.0	(1)	(1)
Germany [3]	1,775	61.1	1,750	60.2	(1)	(1)	(1)	(1)	(1)	(1)
Austria	134	4.6	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Italy	66,963	2,308.4	66,748	2,301.0	67,154	2,315.0	(1)	(1)	(1)	(1)
Japan	580	20.0	592	20.4	(1)	(1)	(1)	(1)	(1)	(1)
Mexico	4,936	170.2	8,519	293.7	7,376	254.3	11,653	401.7	23,137	797.6
New Zealand	18	.6	10	.3			(1)	(1)	(1)	(1)
Rumania	4	.1			(1)	(1)	(1)	(1)	(1)	(1)
Southern Rhodesia					(5)	(5)	(1)	(1)	(1)	(1)
Spain [2]	28,357	977.5	[3] 40,000	[3] 1,378.9	53,441	1,842.3	(1)	(1)	(1)	(1)
Tunisia	25	.9	270	9.3	(1)	(1)	(1)	(1)	(1)	(1)
Turkey	483	16.7	597	20.6	359	12.4	[2] 261	[2] 9.0	(1)	(1)
U. S. S. R.	8,700	[6] 300.0	8,700	[6] 300.0	(1)	(1)	(1)	(1)	(1)	(1)
United States	16,508	569.1	17,991	620.2	18,633	642.3	37,777	1,302.3	44,921	1,548.6
Total [7]	133,136	4,589.6	148,343	5,113.7	(1)	(1)	(1)	(1)	(1)	(1)

[1] Data not yet available.
[2] Exports.
[3] Estimated.
[4] Slovak Metallurgical Works.
[5] Production less than 1 flask or 0.1 metric ton.
[6] Production figure published by Metallgesellschaft.
[7] Sum of figures given in table only.

Australia.—The Metal Bulletin (London) of September 2, 1941, indicated that the mercury property at Kilkivan, Queensland, might double its plant capacity, which had been about 40 pounds a week. Exploitation of adjoining properties was said to be under way.

Development work is also reported to be in progress elsewhere on the continent.

Canada.—Information regarding production of mercury in Canada is again confidential. It is known, however, that since 1939 production in this country has turned sharply upward. The increased output is from the Pinchi Lake property of the Consolidated Mining & Smelting Co. of Canada, Ltd. Production of mercury at the property of Empire Mercury Mines in the Pinchi Lake district is reported to have been discontinued owing to operating difficulties.

Chile.—Mercury ores are said to occur in the Provinces of Atacama, Aconcagua, and Coquimbo but are mined mainly in the last-named. The Compania Minera Pumitaqui, a Chile owned and managed corporation, is reported to be the only concern producing mercury for export. Its property is, however, primarily a gold-copper mine. The output in midyear 1941 was said to be a little over 100 tons of mercury concentrates (containing 2½ to 3 percent mercury) a month, and increased production was in prospect. At that time Japanese interests were bidding for the metal.

China.—Mercury was produced in Kweichow, Hunan, and Szechuan Provinces in 1941; the major part of the production of probably more than 6,000 flasks came from Kweichow. Figures from a reliable source indicated that more than 4,000 flasks were shipped to Russia in June, August, and December and probably additional quantities at other times. Some metal was shipped to India and small quantities to other countries.

Italy and Spain.—Lack of recent data makes it impossible to bring previous annual reports on mercury up to date with regard to Italy and Spain, the leading sources of this commodity. It can be repeated, however, that these nations can doubtless produce approximately 70,000 flasks apiece should demand from available customers require it. Accessibility of the Axis Powers to these outstanding producers of mercury appears to assure very ample supplies to all but Japan, which is shut off by shipping difficulties.

Japan.—The South Africa Mining & Engineering Journal of August 30, 1941, reported that the Yamato Mercury Mining Co. was planning to increase its present rate of mercury production, given as 1,500 to 2,000 flasks annually. Early in 1941, Japan was receiving large quantities of mercury from Mexico and was negotiating for the purchase of Chilean metal. Japanese offers considerably exceeded prices prevailing in the United States. The agreement between the United States and Mexican Governments in July 1941 stopped shipments of Mexican metal to Japan.

Mexico.—Our neighbor republic is one of the few important mercury-producing countries in the world whose production data are available for publication. These show that output during 1941 amounted to 23,137 flasks, double the production of 11,653 flasks attained in 1940, which itself was sharply above the 7,376 flasks recovered in 1939. The largely increased quantities made available during the first 7 months of 1941 went mainly to Japan, to which was consigned 93 percent of the 17,037 flasks exported during that period.

In July an agreement was reached with the Mexican Government whereby the United States was to obtain the surplus production of certain strategic commodities, including mercury, placed under export control by the Mexican Government. Under its terms, this country is obliged to acquire surpluses over and above metal sold through regular commercial channels to customers in the Western Hemisphere that had export limitations similar to the Mexican regulations. The agreement was to be in effect for 18 months and applies to quantities up to 125 percent of exports of such commodities during the 18-month period ended July 1, 1941. Both production and export official totals were much lower after the agreement, but by December they had advanced to figures resembling activity earlier in the year. Data on production and exports in 1941 follow:

Mercury produced in and exported from Mexico in 1941, by months, in flasks of 76 pounds

Month	Production	Exports	Month	Production	Exports
January	1,676	1,666	August	715	705
February	2,446	2,446	September	863	858
March	1,924	1,914	October	549	543
April	3,841	3,796	November	1,072	1,053
May	1,603	1,569	December	2,726	2,726
June	2,738	2,695			
July	2,984	2,951		23,137	22,922

Since July most of the metal exported has come to the United States, although smaller quantities have been consigned to Argentina, Brazil, Colombia, Costa Rica, Cuba, and Uruguay; 62 flasks went to Japan in August.

The following States are reported to contain mercury mines or occurrences of mercury: Aguascalientes, Chihuahua, Durango, Guanajuato, Guerrero, Hidalgo, Jalico, Mexico, Michoacan, Morelos, Oaxaca, Queretaro, San Luis Potosi, and Zacatecas.

The famed Trinidad mine is in the State of San Luis Potosi, and the Huitzuco mine is in Guerrero.

The Pacific Foundry Co., Ltd., of Los Angeles, Calif., reported that it had constructed three 30- to 40-ton and one 20- to 25-ton Nichols Herreshoff plants and one additional retort in Mexico in 1941.

New Zealand.—Mercury is reported being produced by Mercury Explorations, Ltd., at Puhipuhi, after 2 years of preparatory work. The property is situated in barren country traversed by a cinnabar-bearing belt, but commercial ore is found only in scattered areas and pockets. Ore is loaded by mechanical shovel into motor trucks and transported to the treatment plant—an oil-fired, rotary furnace. Recovery of mercury from low-grade deposits at Ngawha and elsewhere was being investigated in 1941.

Peru.—Although little mercury has been produced in Peru in recent years, at one time one of the largest producing properties in the world was active there. Most of the past production has come from the famous Santa Barbara mines, a few miles south of Huancavelica. Wm. C. Vanderburg, foreign mineral specialist of the Bureau of Mines, recently supplied the following data regarding mercury in Peru.

The deposits were discovered in 1570 and up to 1908 had produced 51,362 tons of mercury, equivalent to 1,489,498 flasks (76-pound). This output exceeds that of the New Almaden property in California, largest source of mercury in the United States, which up to 1930 had produced 1,039,675 flasks. During the colonial period, the Santa Barbara deposits supplied not only the mining industry of Peru but also Bolivia, Chile, and Mexico, where the patio process of silver amalgamation was employed. The decadence in the early days of the mines is attributed to exhaustion of the richer ores and to the discovery of mercury in California about 1850. Since 1901 repeated attempts have been made to revive the mines, generally with little success. As current prices for mercury are high, the old workings are being sampled by E. E. Fernandini with the object of treating the lower-grade ores on a large scale. It is reported that there is a large tonnage of low-grade ore containing 0.1 to 0.2 percent mercury; if this is confirmed by sampling, tentative plans call for the erection of a plant capable of treating 500 tons of ore daily. The mercury deposit in the Chonta district, Department of Huanuco, has been under development for the past year by Panaminas, Inc., subsidiary of Ventures, Ltd., of Canada. It is reported that enough ore reserves have been blocked out to justify the erection of a 20-ton-daily-capacity Gould furnace, which has been ordered. Several beds of coal that can be used as furnace fuel occur near the deposit.

Union of South Africa.—According to the Metal Bulletin (London) of May 23, 1941, production of mercury on a small scale was started at Monarch Kap on the Murchison Range, Northern Transvaal, in July 1940. During the latter half of 1940, 3,329 pounds (44 flasks) of mercury were produced, and late in 1941 output was reported to be increasing. Mercury for consumption in South Africa has been previously supplied chiefly by imports from Spain and Italy, according to an article in the March 29, 1941, issue of The Chemical Age. This magazine gives imports of mercury as ranging from 600 to 1,100 flasks a year for 1937 to 1939. The metal is used in gold mining, for the manufacture of explosives, pigments, and scientific instruments, and in medicine; some difficulty in obtaining necessary supplies was anticipated.

Venezuela.—Compania Anonima Minerales de San Jacinto was organized in Caracas in April 1941 to operate a cinnabar mine near La Mesa, Muncipio Chiquinquira, Distrito Torres, in the State of Lara. The mine was expected to reach a monthly capacity of 200 tons of ore. Fifty tons were shipped to the United States for treatment. According to the Anglo-American Metal & Ferro-Alloy Corporation, which purchased the ore, careful sampling, assaying, and rechecking the actual analysis of the ore showed that it contained no more than 2 percent mercury—considerably less than was anticipated. The producing company expected to treat the ore at the mine beginning in January 1942, using retorts made from oil-well casings.

TIN

By E. W. PEHRSON and J. B. UMHAU

SUMMARY OUTLINE

GENERAL SUMMARY

Blockade of the principal sources of tin supply, long feared by students of the United States tin industry, was in sight at the close of 1941 and became a reality early in 1942, precipitating a serious raw-material problem. The Japanese attack on Pearl Harbor on December 7, accompanied by a renewed drive on southeastern Asia, initiated the assault on the world's richest tin-producing area, which was climaxed by the fall of Singapore on February 15, 1942. At the outset of the Japanese offensive, it was widely believed that Singapore was virtually impregnable or at least could hold out long enough to permit completion of United States stock-piling objectives. The amazing speed and success of the Japanese conquest, however, forced the United Nations to drastically adjust their tin-consumption programs downward.

The immediate shock of sharp curtailment of imports into the United States fortunately could be cushioned because of the abnormally large stocks of tin on hand. Despite its late start, the Government stock-piling program had made substantial progress, and industry had been farsighted enough to greatly increase its inventories during recent years. As a result, 107,600 long tons of metallic tin were on hand when Singapore fell—enough for 17 months' consumption at a normal rate of use and sufficient to assure many more months' supply, if uses were restricted to absolutely essential purposes. The Government tin smelter at Texas City was nearing completion, with adequate stocks of ore on hand to assure its operation for several months. As a hedge against possible destruction of British smelters, the initial capacity of the Texas plant was being increased so that it could treat the entire Bolivian output, if necessary. These events, plus prompt Government action in placing all tin in the country under rigid control and in expediting its conservation program, give assurance that enough tin will be available for military needs essential to successful prosecution of the war, although domestic industry and

civilian consumption will undergo severe readjustments. Fortunately these need not be so abrupt as to cause violent disruption of industrial processes.

The forlorn outlook for obtaining any substantial quantity of tin from domestic sources has emphasized the importance to the United States of the Bolivian tin industry, not only from the viewpoint of maintaining or increasing production in that country, but also of safeguarding shipments of ore from submarine attack. Neither of these objectives was in sight on August 1, 1942. Bolivian production was reported to be declining because of labor shortages and rising costs, and the record of ship sinkings since December 7, 1941, is ample evidence that the submarine menace was far from being under control.

Statistically the tin industry of the world established several new records. Mine production exceeded the previous peak reached in 1940 by about 3 percent, and despite the inactivity of Continental European plants smelter output about equaled the previous high. World consumption is estimated to have increased about 3 percent over 1940 but was still below the record of 1937. Consumption of virgin tin in the United States in 1941, however, reached the unprecedented total of 106,000 long tons (processed); during October virgin tin was being used at the rate of 114,000 tons a year. Imports also touched a new high of nearly 141,000 tons, which permitted the substantial increase in stocks previously mentioned. Considering the momentous developments in the tin trade during 1941, prices fluctuated within extremely narrow limits—from a low of 50.10 cents a pound (Straits tin, New York) to a high of 55.00 cents. The Metals Reserve Co. buying policies under its agreement with the Tin Cartel were a restraining factor on the low side, and pressure from Government price-control agencies served similarly on the high side. A ceiling price of 52 cents a pound was established by the Office of Price Administration and Civilian Supply on August 16, 1941.

Salient statistics for tin in the United States, 1925-29 (average) and 1937-41

	1925-29 (average)	1937	1938	1939	1940	1941
Production—						
From domestic mines...long tons..	24	168.4	95	84	49	[1] 62.9
From secondary sources...do....	30,600	27,100	21,000	26,000	29,700	37,500
Imports for consumption (metal)...do....	78,009	88,115	49,699	70,102	124,810	140,878
Exports (domestic and foreign)...do....	1,740	[2] 313	[2] 205	[2] 2,105	[2] 2,664	[2] 1,094
Monthly price of Straits tin at New York:						
Highest... cents per pound..	70.67	62.71	46.23	63.50	54.54	53.35
Lowest...do....	39.79	42.85	36.84	45.62	45.94	50.16
Average...do....	56.64	54.24	42.26	50.18	49.82	52.01
World production...long tons..	163,000	211,000	163,000	177,000	236,000	242,000
Ratio—United States imports to world production...percent..	48	42	30	40	53	58

[1] Subject to revision.
[2] Figures for 1937-41 cover foreign only; domestic not separately recorded.

AXIS CONTROL OF WORLD TIN RESOURCES

As a result of events in 1941 and early 1942, the Axis gained control of the bulk of the world's tin resources. At the outset of the war in 1939, Germany, Italy, and Japan controlled less than 3 percent of the mine output, but with the Japanese conquest of Indochina, Thailand,

British Malaya, Netherlands Indies, Burma, and parts of China, as well as German domination of Europe, the Axis Powers occupied territory that produced 66 percent of the 1940 output. Although this success has assured Japan of tin supplies ample for prosecuting the war, Germany, whose tin supplies are believed to be very low, probably will not profit greatly because of the lack of communications as long as the British fleet controls the Indian Ocean. The chief significance of the shift in control is thus the loss to the United Nations of supplies of an important strategic material. Serious as this is, it is by no means decisive because of the tin ores available in areas still accessible to the Allies, chiefly in Bolivia, Nigeria, and Belgian Congo, which, it has been estimated, will produce approximately 90,000 tons of tin in 1942. Smelting capacity ample for treating these ores soon will be available to the United Nations.

From the longer viewpoint, the delay in rehabilitating mines in the war-torn tin-producing areas after the war is significant. The destruction of mines and equipment by the retreating British and Hollanders, plus the damage that will be inflicted as the Japanese are forced to retreat, will be such that it has been estimated 5 years will be required to restore production to normal.

GOVERNMENT STOCK-PILING PROGRAM

At the beginning of the year all Government tin purchases for stock-piling purposes were being made by the Metals Reserve Co., a subsidiary of the Reconstruction Finance Corporation. Buying continued under the 1-year contract made with the International Tin Committee on June 28, 1940. (See Minerals Yearbook, Review of 1940, p. 669.) In May 1941 the contract was extended to July 1, 1942. The contract provided that the United States agreed to buy all surplus tin offered up to 75,000 long tons a year. Actual purchases were far below the 150,000 tons possible under the contract, because of the abnormally large acquisitions by industry during the period and the fact that world production did not meet expectations. Under the first agreement, the International Tin Committee undertook to increase output to 130 percent of standard tonnages for 1 year, effective July 1, 1940, permitting participating countries to export 272,310 tons for the period. In the 12 months ended June 1941, exports actually totaled 235,074 tons, a 20-percent increase over the 195,834 tons shipped in the preceding 12 months. At the end of 1941, Metals Reserve purchases totaled 65,756 tons, of which 43,511 tons were delivered, 2,700 tons afloat, and 19,545 tons contracted for but not shipped. As of August 15, 1942, over 20,000 tons of Far Eastern tin purchased under the contract were still undelivered.

The Metals Reserve Co. also has commitments for the acquisition of 36,000 tons of tin under the loan agreements to China mentioned in Minerals Yearbook, Review of 1940, but as of December 31, 1941, no deliveries had been reported.

Despite assurances by the Office of Production Management early in July [1] that stock piles would be reserved for defense purposes and that they would not be drawn upon for any instant needs, Metals Reserve Co. began releasing tin to industry during August 1941 when shortages occurred in spot tin owing to shipping delays and Russian

[1] Office of Production Management, Memo to editors: PM 681, July 8, 1941.

purchases in the East. The total quantity released during 1941 was 905 long tons, which left a balance of 42,606 long tons on hand at the end of the year. The 5,478 tons and the 1,955 tons acquired and stored by the Procurement Division and Navy Department, respectively, have remained intact. Thus, at the close of 1941 the Government held 50,039 tons of tin in reserve compared with 20,804 (revised) tons at the close of 1940. In addition, there were 2,700 tons afloat and 55,535 tons contracted for but undelivered.

GOVERNMENT ORE PURCHASES

The United States acquired substantial quantities of tin ore in 1941 under the Metals Reserve Co. contract with Bolivian producers signed November 4, 1940. In addition, the company made an agreement in August 1941 with Netherlands producers for the acquisition of concentrates containing 20,000 long tons of tin from the Netherlands Indies, and contracts for small tonnages were signed with Mexican and South African producers. On June 30, 1942, retroactive to January 1, 1942, the Bolivian agreement was amended by changing the buying price from 48½ cents, f. o. b. U. S. ports, to 60 cents, f. o. b. Chilean and Peruvian ports, and providing for acceptance of concentrates equivalent to 30,000 tons of tin a year in contrast to the 18,000 tons agreed to originally.

By the end of 1941, 45,572 tons of ore had been delivered to the stock pile; 38,368 tons were derived from Bolivia, 7,159 tons from the Netherlands Indies, and 45 tons from South Africa. In addition to the quantity delivered, 251, 623 tons had been purchased or contracted for, including 226,652 tons from Bolivia, 21,341 tons from the Netherlands Indies, and 3,620 tons from Mexico. Data on the tin content of these delivered ores are not available.

Imports of Bolivian ore were begun in April 1941, when ores containing 2,330 tons of tin entered through the Galveston customs district. In September ores from the Netherlands Indies began arriving through New Orleans. The total tin content of ores imported during the year through Galveston and New Orleans was 27,368 long tons, including 21,148 tons from Bolivia and 6,220 tons from Netherlands Indies.

GOVERNMENT TIN SMELTER

Plans for the Government tin smelter at Texas City, Tex., construction of which was begun in October 1941, have been changed. Originally it was designed to treat 50,000 tons of Bolivian ore for the recovery of 18,000 tons of tin a year, but subsequent plans called for 30,000 tons of metal a year from Bolivian ores and 22,000 tons from high-grade alluvial ores. As of August 15, 1942, further extensions to raise the total metal capacity to 74,000 tons a year had been authorized. The expansion was prompted as a precaution against possible destruction of British smelters by bombing or sabotage.

Production of metal from high-grade Netherlands ores began in April 1942, and presmelting treatment of impure Bolivian ores was expected later in the year. The plant is operated by the Tin Processing Corporation under a contract with the Metals Reserve Co.

CONSERVATION

The formal announcement of Japan's alliance with the Axis accentuated the threat of a blockade on tin supplies from Asia and emphasized the need for developing a conservation and substitution program in the United States. In March 1941 the National Academy of Sciences was requested by the Office of Production Management to report on the possibilities of conserving tin. The task was assigned to H. W. Gillett, who worked with a committee under the chairmanship of Zay Jeffries. The formal report, submitted in June, contained many recommendations that subsequently formed the basis of various conservation orders issued by the Government. The report was published by Metals.[2]

By March 1941 the conservation aspects of raw materials reached such importance in the supply situation that a conservation unit was established in the Production Division of the Office of Production Management to direct Government activity in this field. In May 1941, following representations from the industry, producers and consumers of tin plate were called upon to adopt measures for conserving tin by using for certain packs only 1.35 pounds of tin per base box (for years the standard coating on tin plate has been 1.5 pounds per base box), substituting terneplate for tin-coated containers wherever feasible and using black plate wherever tin plate and terneplate were not required. Order M-21e, issued February 4, 1942, established further reductions to 1.25 pounds per base box for ordinary hot-dip plate and 0.50 pound for electrolytic plate; restricted the use of terne metal to terneplate only; and set up a quota system for using tin plate and terneplate. The tin content of terne metal used for terneplate and cans was limited to 15 percent by weight and that used for long ternes to 10 percent. Approximately 90 percent of the tin plate produced is utilized for making containers or cans.

Events following Pearl Harbor necessitated prompt and drastic reduction in the use of tin. On January 27, 1942, can manufacturers were ordered by telegraph to curtail sharply the manufacture, sale, and delivery of tin cans for such commodities as beer and confections in February 1942 to 50 percent of the quantity used for these products during February 1940. This order was superseded by Conservation Order M-81, issued February 11, 1942, in which can sizes were standardized, small sizes being eliminated. A general restriction was imposed on consumption of tin plate by designating the percentage that can be used for various canned products. No limit was placed on cans for fruits, vegetables, milk, and fish of primary importance, which would spoil if not canned when fresh and on which the Department of Agriculture had set production goals. In March 1942 the use of tin containers for nonessential products was discontinued. This group included beer, dog food, dried beans of all kinds (including pork and beans), baking powder, cereals and flour, petroleum products, candy, condiments, and tobacco. Conservation Order M-104, issued April 3, 1942, and Amendment 1 of April 20 restrict use of tin plate and terneplate as covers for glass containers, including crown caps for beverages and cover caps for home preserving.

[2] Gillett, H. W., Tin Conservation and Substitution: Metals, July 1941, pp. 6-9; August 1941, pp. 6-9; and September 1941, pp. 6-12.

Use of tin in products other than tin plate or terneplate has also been restricted. Drastic reductions in the consumption of tin in tin foil, tin alloys, tin oxide, type metal, collapsible tubes, etc., have been ordered by the Government. Tin content of solder has been reduced to a maximum of 30 percent, effective May 1, 1942. The use of tin in numerous articles, such as musical instruments, automobile body solder, office staples, jewelry, kitchen equipment, etc., during the first quarter of 1942 was limited to 50 percent of the amount used in the same quarter of 1940 and prohibited thereafter.

Order M–115, issued April 1, 1942, eliminates the use of collapsible tin tubes for foods, cosmetics, and many toilet preparations. Individuals purchasing tubes of toothpaste or shaving cream must turn in an empty tube for each new tube bought. Pure tin tubes are permitted only for certain pharmaceutical preparations. The old tubes are to be salvaged through the Tin Salvage Institute as agent for Metals Reserve Company.

INVESTIGATION OF DOMESTIC TIN DEPOSITS

The Bureau of Mines and the Geological Survey continued their investigation of domestic tin deposits. In May 1941 the Bureau of Mines issued a summary [3] reporting progress in its tin-exploration program, which contained the following conclusion:

> Two of the largest known tin-bearing areas in the country were explored, one in South Dakota and the other in southwestern New Mexico, which confirmed the opinion that no deposits are likely to be found in the United States that can supply any substantial quantity of tin even at prices several times the normal present price.

Deposits near Spokane, Wash., containing both tin and tungsten, were explored by the Bureau of Mines by surface trenching. According to a press release of the Geological Survey dated August 18, 1941, the largest deposit exposes about 500 tons of ore containing about 3 percent tin, and the presence of perhaps 20,000 tons of lower-grade material has been determined. The deposits have been known since 1906, and by 1912 about 150 tons of material containing 3 to 6 percent tin had been mined and stacked on the dump. There are no recorded shipments from this property.

The Coosa County (Ala.) tin belt, which was examined by the Bureau of Mines in 1939, was reexamined early in 1942 to determine whether recent developments had indicated continuity of tin-bearing pegmatites. Extensive trenching revealed little continuity and no appreciable amount of cassiterite.

The Geological Survey reported in August 1941 that its examination of virtually all known tin deposits from Lincolnton, N. C., southwest to Gaffney, S. C., showed that the bedrock deposits, individually or as a group, cannot yield more than small amounts of tin. Possibly a few can be worked profitably on a small scale if the price of tin rises sufficiently. In 1939 the Bureau of Mines conducted concentrating tests on a sample of tin ore from North Carolina.[4]

Tin deposits near Battle Mountain, Lander County, Nev., were described in a report by the Geological Survey,[5] which concluded that

[3] Mining Division. Exploration and Sampling of Domestic Deposits of Strategic Minerals: Bureau of Mines Rept. of Investigations 3574, 1941, p. 7.

[4] Shelton, S. M., and Engel, A. L., Progress Reports—Metallurgical Division. 45. Ore-Testing Studies, 1939-40: Bureau of Mines Rept. of Investigations 3425, 1941, pp. 14–15.

[5] Fries, Carl, Jr., Tin Deposits of Northern Lander County, Nev.: Geol. Survey Bull. 931–L, 1942, 15 pp.

selective mining of the tin-bearing veinlets would not pay, owing to their narrowness and discontinuity, and it seems equally certain that the deposits could not be mined by bulk methods. A few tons of cassiterite might be recovered from veins by narrow stoping and hand sorting, and from thin placer deposits of gravel in small pockets. This tin-bearing area was described in a Bureau of Mines report in 1939.[6]

At Majuba Hill, Pershing County, Nev., cassiterite appears widely scattered in very small amounts and is abundant only in a single underground ore shoot so small that it could not be mined at a profit.[7] As now exposed, the shoot, which is cut off by a fault, may contain 12,000 pounds of metallic tin. Its utilization depends on finding additional ore reserves by prospecting aimed at locating the offset part of the high-grade shoot, discovering additional shoots or a large body of low-grade ore.

The results of a study of the tin deposits of Irish Creek, Va., by the Geological Survey, announced in April 1942, suggest that further prospecting in the area may be warranted. As only a small part of the district has been explored, the extent of its tin deposits is still undetermined. The Geological Survey has done some work on tin deposits of the Temescal district and the Bernice group of claims near Cima, San Bernardino County, Calif. A shipment of low-grade tin ore from the Cima property is understood to have been made in 1942 to the Tin Processing Corporation. A systematic survey of all known tin occurrences in California has been made by Segerstrom,[8] who states

> The future of tin mining in California, unfortunately, does not look encouraging. Repeated failures in operations that have been attempted, lack of ore bodies of suitable size and value, lack of reports of new and substantial occurrences, all add up to a general dismissal of possible future operations in this State.

The tin-bearing pegmatites of the Tinton district, South Dakota, were reported on by the Geological Survey.[9]

In 1941 the Geological Survey sent geologists into the Seward Peninsula and the Hot Springs district to make intensive investigation of all possible sources of tin there. Although these investigations have not yet been completed as of August 1942, none of the parties has found deposits that appeared to contain a large supply of tin that could be worked at a profit under existing conditions.

On May 25, H. R. 7131, authorizing the Metals Reserve Co. to purchase for the United States all tin produced in this country at $1.00 a pound, was introduced in the 77th Congress, 2d Session, and referred to the Committee on Mines and Mining. H. R. 96, authorizing an appropriation of $2,000,000 for exploration and development of Alaska tin deposits, was introduced January 3, 1941, but no action was taken.

In March 1942 the Reconstruction Finance Corporation announced the adoption of a plan to encourage producers to speed development of small ore deposits containing strategic and critical metals and

[6] Vanderburg, William O., Reconnaissance of Mining Districts in Lander County, Nev.: Bureau of Mines Inf. Circ. 7043, 1939, pp. 54-57.

[7] Smith, Ward C., and Gianella, V. P., Tin Deposit at Majuba Hill, Pershing County, Nev.: Geol. Survey Bull. 931-C, 1942, 20 pp.

[8] Segerstrom, Richard J., Tin in California (prepared under direction of Charles A. Dobbel, Professor of Mining, Stanford University): State of California Dept. of Natural Resources, Division of Mines, California Jour. Mines and Geology, vol. 37, No. 4, October 1941, pp. 531-557.

[9] Smith, Ward C., and Page, Lincoln R., Tin-Bearing Pegmatites of the Tinton District, Lawrence County, S. Dak.—A Preliminary Report: Geol. Survey Bull. 922-T, 1941, 36 pp.

minerals. The owner or lessee of properties giving reasonable promise of success may now obtain an initial loan without mortgage of not more than $20,000, repayable out of proceeds from production. If the results of such development are favorable, additional loans up to $20,000 may be made for further development.

LICENSING OF EXPORTS

The Department of State issued no licenses for export of tin-plate scrap during 1941. Exports of all other tin-bearing commodities are subject to controls and license by the Board of Economic Warfare, except those authorized by the Office of Lend-Lease Administration. Data on the quantity of tin authorized for export have not been released.

DOMESTIC PRODUCTION

MINE OUTPUT

Only 63 long tons of tin were produced in 1941—an increase, however, of about 28 percent from 1940. Alaska again supplied virtually all the output. According to the Federal Geological Survey, tin mining in Alaska in 1941 was confined mainly to placer deposits that have been developed in the western part of the Seward Peninsula near Tin City. It is understood that dredging operations in that area have now been suspended and equipment dismantled. Small amounts of stream tin were recovered in the course of placer-gold mining in the Hot Springs and Ruby districts of the Yukon region. No lode tin was mined during 1941 from any Alaska deposits.

In addition to Alaska, small quantities were reported produced in Alabama, Montana, New Mexico, and South Dakota in 1941. Producers included the Coosa Cassiterite Corporation near Rockford, Ala.; George A. Mayer near Basin, Mont.; W. Barker and W. A. McCalla, Paul D. Bellamy, Curtis C. Johnson, and H. E. Van Sant in the Black Range, N. Mex.; and the Black Hills Tin Co. near Tinton and Black Hills Keystone Corporation near Keystone, S. Dak.

A historical table of mine production of tin in the United States, by States, from 1910 to 1938, inclusive, was published in Minerals Yearbook, 1939 (p. 679).

Mine production of tin (content) in the United States, 1937–41, by States

Year	Long tons				Value
	Alaska	South Dakota	Other States [1]	Total	
1937	166	0.8	1.6	168.4	$205,300
1938	94	1		95	90,000
1939	33	.5	.5	34	38,400
1940	46	2	1	49	54,900
1941	[2] 53.4	1.4	8.1	[2] 62.9	[2] 73,200

[1] 1937: South Carolina, New Mexico, and Wyoming; 1939–40: Montana and New Mexico; 1941: Alabama, Montana, and New Mexico.
[2] Subject to revision.

DOMESTIC TIN SMELTING

Tin ores were treated on a small scale in this country in 1941. Several privately owned plants recovered 1,839 long tons of tin, includ-

ing 502 tons in the form of pig tin and 1,337 tons in the form of alloys (mostly solder) made direct from the ores. In 1940 (revised figures), 1,391 tons were recovered—510 tons as pig and 881 as alloys. The total recovered was 32 percent greater than in 1940, the production of pig tin being slightly less while that of tin alloys increased 52 percent. The Government plant at Texas City, Tex., did not begin producing pig tin until April 1942.

The ores treated at domestic plants in 1941 were obtained chiefly from Latin American countries, principally Bolivia, although small quantities produced by domestic mines were also purchased. Companies reporting the recovery of tin from ores in 1941 include American Metal Co., American Smelting & Refining Co., Franklin Smelting & Refining Co., Kansas City Smelting Co., Metal & Thermit Corporation, Nassau Smelting & Refining Co., Phelps Dodge Refining Corporation, and Vulcan Detinning Co.

SECONDARY TIN

Recovery of secondary tin established a new record in 1941, with a 27-percent increase over 1940. The increase was due principally to greatly accelerated industrial demand prompted by the national defense program and higher prices. In appraising the significance of secondary tin as a factor in national supply, it should be borne in mind that a very large proportion (approximately 80 percent in 1941) is contained in alloy scrap from which the tin seldom is isolated but merely revolves in the various cycles of use, purification, and re-use of the alloys themselves.

Secondary pig tin recovered by detinning plants in 1941 totaled 4,500 tons (3,700 tons in 1940), mostly from clean tin-plate scrap with only a small tonnage (about 60 tons) from old tin-coated containers. Further details on secondary tin are given in the chapter on Secondary Metals—Nonferrous.

Secondary tin recovered in the United States, 1925–29 (average) and 1937–41

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal (long tons)	In chemicals (long tons)	Total (long tons)	As metal (long tons)	In alloys and chemicals (long tons)	Total	
						Long tons	Value
1925–29 (average)	900	2,000	2,900	7,500	23,100	30,600	$38,034,120
1937	2,500	1,500	4,000	7,400	19,700	27,100	32,124,100
1938	2,200	1,300	3,500	4,300	16,700	21,000	19,284,600
1939	3,600	600	4,200	4,000	22,000	26,000	29,276,600
1940	3,700	600	4,300	4,500	25,200	29,700	33,102,400
1941	4,500	950	5,450	5,300	32,200	37,500	43,722,700

CONSUMPTION

APPARENT CONSUMPTION

The apparent consumption of primary pig tin is determined by adding domestic smelter production to net imports. As there was no recorded smelter output from 1925 to 1939, inclusive, the apparent consumption for this period was equivalent to net imports. The

computation does not consider fluctuations in dealer and consumer stocks (information on which is not always available) or the large accumulation in Government stocks; consequently the figures do not reveal the actual trend in consumption. Nevertheless, statistics on apparent consumption have been useful in determining long-time trends. A table giving these data from 1910 to 1938 was published in Minerals Yearbook, 1939 (p. 680).

The apparent consumption of primary pig tin, computed by the above formula, reached an all-time record of 141,618 tons in 1941—a 15-percent increase over the 123,537 tons consumed in 1940—but, as indicated above, these figures exaggerate actual consumption because of very large increases in consumers' and Government stocks. Nevertheless, actual consumption of primary tin in 1941 reached a new peak, being considerably higher than in 1940, and exceeded by 15 percent the consumption of 1929, when the previous record was established.

CONSUMPTION BY USES

The following tables show the actual consumption of primary and secondary tin as reported to the Bureau of Mines. The items included in the table of consumption by uses represent the products of the first cycle of manufacture. In computing the figures shown in the table, any primary tin emerging from the first stage of manufacture as scrap was recorded as secondary metal. The figures thus understate consumption of primary tin, and some of the secondary tin listed duplicates the virgin metal shown because it is reclaimed from such byproducts as tin-plate clippings and virgin drosses from tin-plate and tinning mills and other plants consuming virgin tin. In 1941, for example, domestic consumers received 114,281 tons of virgin metal, of which 8,252 tons were added to inventories and 106,029 tons processed. Of the tin processed, about 4,200 tons were sold as scrap, lost, or added to stocks of metal in process, and the remainder emerged from the first stage of manufacture in the products shown in the following tables.

Consumption of primary and secondary tin in the United States, 1937–41, in long tons

	1937	1938	1939	1940	1941
Stocks on hand Jan. 1	17,978	25,984	25,260	29,025	56,999
Net receipts during year [1]	101,354	61,431	89,018	128,030	149,123
Available supply	119,332	87,415	114,278	157,055	206,122
Stocks on hand Dec. 31	25,984	25,260	29,025	56,999	[2] 67,421
Total processed during year	93,348	62,155	85,253	100,056	138,701
Intercompany transactions in scrap (tin content)	2,782	2,122	2,390	2,190	2,936
Total consumed in manufacturing	90,566	60,033	82,863	97,866	135,765
Plant losses	436	[2] 259	435	712	1,070
Tin content of manufactured products	90,130	59,774	82,428	97,154	134,695
Primary	72,928	48,116	[3] 66,583	[3] 72,324	[3] 103,086
Secondary	17,202	11,658	15,845	24,830	31,609

[1] 1937: Primary, 82,946 tons; secondary, 3,461; terne, 1,052; scrap, 13,895. 1938: Primary, 50,052, secondary 1,983; terne, 787; scrap, 8,609. 1939: Primary, 70,732; secondary, 4,976, terne, 1,171; scrap, 12,139. 1940: Primary, 98,125; secondary, 5,409; terne, 1,086; scrap, 23,410. 1941: Primary, 114,281; secondary, 6,879; terne, 1,851; scrap, 26.112.

[2] Not including 2,700 tons in transit or in warehouses.

[3] Includes small tonnage secondary pig tin.

Consumption of tin in the United States, 1937–41, by finished products (tin content), in long tons

Product	1937			1938			1939			1940			1941		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	[1] 39,221	(1)	39,221	[1] 23,545	(1)	23,545	[1] 36,640	(1)	36,640	[1] 38,674	(1)	38,674	[1] 44,854	(1)	44,854
Terneplate	382	1,015	1,397	264	743	1,007	317	1,137	1,454	455	1,058	1,513	917	1,129	2,046
Solder	12,026	7,832	19,858	7,590	5,208	12,798	9,578	7,701	17,279	10,222	8,797	19,019	18,084	10,141	28,225
Babbitt	4,501	2,272	6,773	2,893	1,264	4,157	3,850	1,598	5,448	4,473	3,173	7,646	7,495	3,104	10,599
Bronze and brass	3,712	2,784	6,496	2,334	1,598	3,932	3,385	3,051	6,436	5,444	9,216	14,660	10,067	13,103	23,170
Collapsible tubes	3,571	(2)	3,571	3,427	-	3,427	3,507	(2)	3,507	3,512	(2)	3,512	4,233	212	4,445
Tinning	2,585	67	2,652	1,738	35	1,773	2,165	172	2,337	2,455	265	2,720	3,987	145	4,132
Foil	1,456	4	1,460	2,283	(2)	2,283	2,001	(2)	2,001	1,713	-	1,713	4,292	-	4,292
Chemicals (other than tin oxide)	171	1,331	1,502	166	910	1,076	167	288	455	52	330	382	280	690	970
Pipe and tubing [3]	1,278	18	1,296	948	(2)	948	606	(2)	606	661	(2)	661	1,325	(2)	1,325
Tin oxide	793	411	1,204	547	444	991	651	359	1,010	651	506	1,157	995	495	1,490
Type metal	221	1,140	1,361	134	978	1,112	149	990	1,139	84	1,048	1,132	287	1,528	1,815
Galvanizing	997	(2)	997	792	-	792	1,028	-	1,028	963	-	963	863	104	967
Bar tin	652	174	826	456	213	669	1,100	241	1,341	1,000	91	1,091	1,526	607	2,133
Miscellaneous alloys	482	24	506	238	19	257	404	45	449	353	11	364	480	137	617
White metal	374	33	407	390	44	434	466	42	508	953	83	1,036	[4] 2,463	[4] 98	[4] 2,561
Miscellaneous	506	97	603	371	202	573	569	221	790	659	252	911	938	116	1,054
	72,928	17,202	90,130	48,116	11,658	59,774	66,583	15,845	82,428	72,324	24,830	97,154	103,086	31,609	134,695

[1] Primary includes small tonnage of pig tin derived from detinning operations; Bureau of Mines not permitted to publish separate figures.
[2] Small quantity included under "Miscellaneous."
[3] In 1937 pure tin tubing required 1,286 tons and tin-lined tubing 10 tons; not reported separately after 1937.
[4] Includes 454 tons of primary and 20 of secondary for Britannia ware and 64 tons of primary and 8 of secondary for pewter.

Tin is employed principally in the manufacture of tin plate. Normally this industry consumes approximately half of the virgin tin used in the United States. Tin-plate production rose to a new high in 1941, as the total food pack was the largest in history.

The use of primary tin in various other products increased as follows in 1941: Solder 77 percent, babbitt 68 percent, bronze and brass 85 percent, type metal 242 percent, collapsible tubes 21 percent, foil 151 percent, tinning 62 percent, pipe and tubing 100 percent, chemicals 438 percent, tin oxide 53 percent, and bar tin 53 percent. The use of primary tin for galvanizing declined 10 percent.

FOREIGN TRADE [10]

The principal items in the foreign trade of the United States in tin are imports of pig tin (which supply virtually all the domestic tin requirements) and exports of tin plate. In 1941 a large quantity of tin concentrates was imported and placed in storage for smelting at Texas City, Tex. Of minor importance are the import and export trade in tin-plate scrap; exports of tin-plate circles, strips, cobbles, etc.; and exports of waste-waste tin plate. There is also an appreciable export of miscellaneous tin manufactures, tin-plated hollow ware, and tin compounds.

Imports of metallic tin in 1941 were 13 percent greater than in 1940, establishing an all-time record. Of the total, 89 percent came from Asia, 8 percent from Africa, and 3 percent from Europe and Australia. Receipts from Asia increased 10 percent, and those from Africa more than doubled. Imports of tin concentrates (which were the largest since 1920) were consigned chiefly to the Government tin smelter at Texas City, Tex. The first shipment for treatment at this new smelter arrived in April. The tin content of the ores and concentrates imported was 28,670 tons from the following sources: Bolivia 22,021 tons, Netherlands Indies 6,220, Africa 198, Mexico 114, Argentina 102, and others 15.

Foreign trade of the United States in tin and tin concentrates, 1937–41

Year	Imports				Exports of tin (metal) [1] (long tons)
	Tin (metal)		Tin concentrates (tin content)		
	Long tons	Value	Long tons	Value	
1937	88,115	$104,284,762	151	$132,810	313
1938	49,699	44,860,324	(2)	298	205
1939	70,102	70,590,764	500	418,004	2,105
1940	124,810	128,294,410	3,000	2,687,154	2,664
1941	140,873	149,569,328	28,670	27,671,689	1,094

[1] Imported as pigs, bars, etc., and exported as such.
[2] Less than 1 ton.

[10] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Tin [1] imported for consumption in the United States, 1940–41, by countries

Country	1940		1941	
	Long tons	Value	Long tons	Value
Australia	711	$760, 641	250	$270, 956
Belgian Congo	4, 899	5, 527, 493	11, 030	10, 397, 351
Belgium	40	42, 560		
British Malaya	96, 454	98, 606, 535	104, 872	112, 798, 138
Canada	7	2, 036	5	5, 644
China	3, 889	3, 591, 865	2, 845	2, 702, 373
Hong Kong	480	415, 452	4	4, 248
Indochina, French	1, 241	1, 340, 956	487	545, 814
Mexico	23	18, 333		
Netherlands	10	5, 086		
Netherlands Indies	12, 101	12, 916, 449	17, 739	18, 883, 180
Panama	(2)	98		
Portugal	104	86, 044		
United Kingdom	4, 851	4, 980, 862	3, 641	3, 961, 624
	124, 810	128, 294, 410	140, 873	149, 569, 328

[1] Bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n s p f.
[2] Less than 1 ton.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1937–41, in long tons

Year	Tin-plate scrap		Tin-plate circles, strips, cobbles, etc., exports	Waste-waste tin plate, exports	Tin plate, taggers tin, and terneplate	
	Imports	Exports			Imports	Exports
1937	12, 916	14, 126	13, 062	23, 259	246	360, 683
1938	10, 444	12, 495	4, 467	7, 254	109	161, 576
1939	12, 633	10, 204	6, 552	9, 132	99	311, 016
1940 [1]	16, 615	3, 536	4, 590	6, 091	137	383, 328
1941 [1]	22, 600	180	4, 952	8, 321	109	354, 940

[1] In addition, 15,153 long tons of terneplate clippings and scrap valued at $474,374 were exported in 1940, and 715 long tons valued at $43,545 in 1941, not separately classified before January 1, 1940.

Foreign trade in miscellaneous tin manufactures and tin compounds, 1937–41

Year	Miscellaneous tin manufactures		Tin compounds (pounds)	
	Imports [1]	Exports [2]	Imports	Exports
1937	$50, 545	$2, 532, 747	1, 715	218, 006
1938	19, 453	2, 064, 515	865	172, 467
1939	20, 106	1, 098, 140	5	204, 362
1940	12, 429	706, 425	271	131, 019
1941	2, 266	1, 456, 353	7, 224	137, 424

[1] Includes tin manufactures, n s p f, tin foil, tin powder, flitters, and metallics
[2] Includes tin dross and tin-bearing scrap material other than tin-plate scrap.

Exports of tin plate, etc., decreased 7 percent owing chiefly to loss of markets in Europe and Asia in consequence of the war. There were large increases in shipments to South America and Australia. For the 12-month period beginning December 15, 1941, 218,600 metric tons of tin plate have been allotted for export to Latin America by the Supply Priorities and Allocations Board at the request of the Economic Defense Board. Shipments to Latin America and Canada, which represented 58 percent of the total, increased 15 percent in 1941.

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1940–41, by principal countries and customs districts

Country and customs district	1940		1941	
	Long tons	Value	Long tons	Value
COUNTRY				
Argentina	35, 037	$4, 097, 755	48, 081	$6, 431, 925
Australia	1, 982	220, 547	50, 457	5, 883, 653
Brazil	56, 902	6, 495, 308	63, 506	7, 697, 843
British East Africa	21	2, 483	3, 695	386, 746
British Malaya	8, 613	1, 020, 259	13, 018	1, 459, 758
Canada	26, 524	2, 955, 990	30, 023	3, 453, 480
Chile	8, 332	939, 107	8, 984	1, 096, 287
China	19, 610	2, 038, 933	1, 811	184, 013
Colombia	4, 173	497, 180	3, 762	448, 665
Cuba	10, 918	1, 315, 679	17, 271	2, 161, 000
Egypt	6, 282	748, 146	9, 107	965, 920
Greece	4, 106	440, 210	137	15, 283
Hong Kong	3, 339	340, 387	2, 537	257, 765
India, British	8, 573	1, 003, 567	6, 456	728, 044
Indochina, French	2, 002	215, 918	19	1, 814
Italy	3, 817	514, 171		
Japan	9, 471	1, 112, 349		
Mexico	14, 769	1, 782, 045	16, 888	2, 070, 121
Netherlands	16, 633	2, 158, 170		
Netherlands Indies	7, 349	818, 676	5, 697	731, 299
New Zealand	1, 790	19, 321	11, 739	1, 395, 362
Norway	5, 664	617, 428		
Paraguay	133	17, 690	1, 819	223, 508
Peru	5, 215	562, 483	2, 843	334, 254
Philippine Islands	13, 947	1, 536, 056	6, 091	694, 044
Portugal	15, 622	1, 906, 663	3, 390	409, 916
Spain	9, 083	1, 072, 987	52	5, 697
Sweden	12, 100	1, 271, 691	49	5, 037
Switzerland	7, 678	1, 054, 833	10	1, 265
Turkey	1, 774	201, 939	35	3, 938
Union of South Africa	24, 604	2, 754, 358	23, 909	2, 758, 649
U. S. S. R	3, 348	509, 483	4, 664	698, 382
Uruguay	15, 694	1, 848, 135	11, 340	1, 423, 940
Venezuela	2, 237	261, 992	1, 886	232, 968
Other countries	15, 986	2, 022, 956	5, 664	674, 570
	383, 328	44, 374, 895	354, 940	42, 835, 146
CUSTOMS DISTRICT				
Buffalo	6, 623	725, 085	7, 255	811, 393
Dakota	8, 439	978, 882	12, 940	1, 556, 150
Florida	2, 430	282, 651	3, 854	495, 213
Maine and New Hampshire	2, 133	267, 375	2, 927	398, 146
Maryland	135, 007	14, 911, 145	79, 172	9, 339, 804
Michigan	6, 136	626, 747	5, 156	485, 779
New Orleans	7, 195	807, 022	8, 198	993, 946
New York	193, 844	23, 213, 471	218, 835	26, 622, 559
Philadelphia	12, 119	1, 482, 326	2, 494	289, 536
Other districts	9, 402	1, 080, 191	14, 119	1, 842, 620
	383, 328	44, 374, 895	354, 940	42, 835, 146

PRICES

The average quoted price of Straits tin for prompt delivery in New York in 1941 was 4 percent higher than in 1940 but 4 percent under the 1937 average, which was the high for the last decade. On August 16, 1941, a ceiling price of 52 cents a pound was established by the Government. At the beginning of 1941 the quotation stood at 50.10 cents a pound, the lowest at any time during the year. By the middle of January prices began moving upward, at first fractionally and then sharply after the middle of February upon reports of an impending breach between the United States and Japan. The price reached 54.25 cents on February 20. This prompted the Office of Production Management to warn that bidding up of price would neither increase the total supply of tin in the country nor the amount available to particular consumers, no matter what they may

have paid for it. Consumers were advised that if supplies of tin from the Far East should be interrupted immediate steps would be taken to conserve domestic supply and that all stocks, whether in Government or private hands, would become subject to allocation upon the basis of national defense requirements. Prices dropped promptly to 51.25 cents on March 1 but rose again to 52.75 cents on March 20. A slight decline began the first part of April, as there had been a check in the German plans in the Balkans, the Italian fleet had suffered a defeat, and the British Army had met with some success in Africa, making the prospect of a Japanese move in the Far East much less menacing. Thereafter, as the progress of the war changed, prices again trended upward. In July aggressive moves by Japan into and around Indochina, the Vichy Government acceptance of Japan's occupation of that country, and freezing of Japanese assets by the United States and Great Britain caused sharp increases in price. On July 25 quotations reached the highest for the year—55 cents—an increase of almost 5 cents since the beginning of the year and more than 2 cents since July 1. As a result, the Office of Price Administration and Civilian Supply on July 28 warned that this increase might force imposition of a price ceiling on the metal in the near future and expressed the hope that prices would stabilize around the level of the Government buying price—50 cents a pound. At the same time the chief of the Tin Branch of the Office of Production Management requested consumers not to buy if their stocks exceeded by 50 percent what they held in June 1940. As a consequence, quotations promptly settled to 52 cents, nominal. Early in August, concern over shipments of tin from the Far East became so alarming (Russia began buying Straits tin in considerable quantity during August) that an inflationary situation developed which necessitated issuance of an order by the Office of Price Administration and Civilian Supply establishing a ceiling price of 52 cents a pound, effective August 16.

In London the monthly average price for standard tin, spot delivery, ranged downward from a high of £270.1 a long ton in March to the low of £255.8 in October. The average for the year approximated £261.1, compared with £256.4 in 1940. Dealings on the London Metal Exchange were suspended December 9. The price averaged £257.6 for the six market days that preceded the suspension of trading. The closing price on December 8 was £259.10. With the closing of the exchange, the British Government attained control of tin prices, supplying consumers with their essential requirements at a basic price of £275 a ton, for tin with a minimum of 99 percent, delivered at works. Singapore failed to function as a market after December 13. It was bombed by the Japanese on Sunday night, December 14, and penetrated by Japanese military forces on February 9, 1942.

Tin price data, 1925–29 (average) and 1937–41

	1925-29 (average)	1937	1938	1939	1940	1941
Average prices						
New York [1]						
Straits tin ....cents per pound	56 64	54 24	42 26	50.18	49.82	52.01
99 75-percent tin (English refined)... do	(2)	54 06	42 07	[3] 47 84	[4] 48 79	(5)
99-percent tin.............. do	55 50	53 01	40 84	[6] 46.35	[4] 49.98	51.28
London [7]						
Standard tin........ £ per long ton	254 6	242 3	189 6	226 3	256 6	[8] 261.6
Do .... cents per pound [9]	55 17	53 48	41 39	44 81	[10] 43.87	[10] 47.09
Premium allowed over standard						
Straits........ £ per long ton	5 1	3 0	4 3	(2)	(2)	(2)
Banka........do	6 9	....	....	(2)	(2)	(2)
English .... do	− 7	4	1 3	(2)	(2)	(2)
Price indexes (1925-29 average=100)						
Straits tin (New York)	100	96	75	89	88	92
Copper (New York)	100	90	70	75	77	80
Lead (New York)	100	80	63	68	69	78
Nonferrous metals [11]	100	91	74	79	82	85
All commodities [11]	100	88	80	79	80	89

[1] American Metal Market [2] Data not available [3] 10-month average. [4] 7-month average
[5] January-August, nominal, September-December, 51.62 cents
[6] 9-month average
[7] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[8] 11-month average
[9] Conversion of British quotations into American money based upon average rates of exchange recorded by the Federal Reserve Board of the Treasury
[10] Based upon free exchange rate
[11] Based upon price indexes of U. S. Department of Labor

Monthly price of Straits tin for prompt delivery in New York, 1939–41, in cents per pound [1]

Month	1939			1940			1941		
	High	Low	Average	High	Low	Average	High	Low	Average
January	46 80	45 15	46 38	48 75	45 12½	46 72	50 50	50 10	50 16
February	46 37½	45 00	45 62	48 00	45 00	45 94	54 25	50.25	51.40
March	46 70	45 75	46 21	49 00	45 62½	47 09	52 62½	51 25	52 05
April	49 25	46 10	47 20	47 50	44 75	46 82	52 50	51 50	51 96
May	49 25	48 70	49 02	55 00	47 12½	51 48	52 25	51 75	52 16
June	49 10	48 25	48 85	58 00	42 12½	54 54	53 12½	52 12½	52 67
July	48 75	48 40	48 52	52 75	51 00	51 59	55 00	52 50	53.35
August	49 50	48 12½	48 76	52 62½	50 50	51 18	53 00	52 00	52 36
September	75 00	50 00	63 50	51 50	50 05	50 32	52 00	52 00	52 00
October	56 00	55 00	55 25	51 87½	51 00	51 49	52 00	52 00	52 00
November	54 00	50 00	52 24	51 00	50 20	50 56	52 00	52 00	52 00
December	52 25	49 00	50 64	50 20	50 05	50 11	52 00	52 00	52 00
Year	75 00	45 00	50 18	58 00	44 75	49 82	55 00	50 10	52 01

[1] Metal Statistics, 1942, pp 425 and 427.

STOCKS

Total year-end stocks of virgin tin in the United States in 1941, including metal afloat but excluding Government stock piles in the United States, were 4 percent below those of 1940. Visible supplies decreased 42 percent, while consumers' stocks rose 22 percent. Including tin afloat and Government stock piles, metal on hand at the end of 1941 was equivalent to about 13 months' supply at the average rate of consumption in 1941. In August the Metals Reserve Co. began releasing tin from stocks for industrial purposes. On December 18 all supplies of tin became subject to special allocation. Thereafter no tin, including metal afloat, could be sold or delivered without specific permission, and imports could be sold only to the Government. The Government stock pile of pig tin was greatly augmented,

so that by the close of the year 50,000 tons were on hand and in addition 45,600 tons of tin ore were awaiting treatment by the smelter, which was being rushed to completion at Texas City.

During 1941 the Bureau of Mines canvassed tin consumers to determine stocks and use. According to these reports, the consuming industry had 54,100 tons of primary pig tin at plants at the end of 1941, including 34,950 tons held by tin-plate manufacturers. The industry also had 2,700 tons of virgin tin in transit or warehoused in addition to 880 tons of secondary pig tin on hand at the end of the year.

Stocks of virgin pig tin in the United States, December 31, 1937-41, in long tons

	1937	1938	1939	1940	1941
Location of stocks:					
Afloat to United States [1]	7,678	4,150	12,663	22,627	[2] 15,000
At landings in New York [1]	4,106	1,837	2,415	6,106	3,129
In licensed warehouses in New York [1]	2,279	3,320	887	3,073	371
Total visible supply [1]	14,063	9,307	15,965	31,806	18,500
Consumers' stocks [3]	17,678	17,851	21,111	[4] 46,574	[5] 56,842
Total stocks on hand	31,741	27,158	[6] 37,076	[6] 78,380	[6] 75,342

[1] As reported by Commodity Exchange, Inc.
[2] Estimated.
[3] As reported to the Bureau of Mines, does not include tin in process or secondary pig tin.
[4] Revised figures.
[5] Includes 2,700 tons in transit in the United States and at other warehouses not contained in figures above for "at landings" and "in licensed warehouses."
[6] Exclusive of Government purchases delivered.

Visible stocks of tin in the world and in the United States at end of each month, 1925-29 (average) and 1937-41, in long tons [1]

Month	1925-29 (average)		1937		1938		1939		1940		1941	
	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.
January	18,912	2,986	29,099	5,478	30,493	4,866	39,100	4,624	35,573	1,749	44,719	9,442
February	19,620	3,027	26,341	4,956	29,002	5,116	40,035	5,486	33,148	2,078	44,107	7,489
March	18,312	2,803	27,526	5,731	34,872	4,458	37,788	5,806	32,339	2,635	39,971	5,195
April	17,765	2,189	27,168	4,741	35,359	4,447	37,224	3,385	32,149	2,964	38,788	5,016
May	19,085	2,384	27,320	5,144	33,051	3,679	33,715	3,387	30,562	3,677	40,777	7,205
June	18,250	2,390	27,073	4,810	35,844	4,247	30,039	4,388	31,869	5,300	38,600	2,846
July	18,164	2,675	28,938	6,193	39,119	4,071	29,615	5,339	38,736	6,567	(2)	5,864
August	18,339	2,450	29,371	5,850	41,701	5,232	26,338	3,613	38,040	6,583	(2)	2,393
September	18,317	2,425	26,099	3,538	40,544	4,573	31,168	3,413	39,450	9,438	(2)	1,767
October	18,356	2,899	24,858	3,280	38,915	4,500	38,206	3,536	40,631	6,623	(2)	1,127
November	19,058	2,373	26,176	5,285	37,145	5,060	38,035	3,283	40,046	4,362	(2)	2,186
December	20,557	2,277	29,416	6,385	37,712	5,157	38,280	3,302	44,678	9,179	(2)	3,500
Average	18,744	2,573	27,449	5,116	36,149	4,617	34,962	4,130	36,435	5,096	(2)	4,502

[1] Metal Statistics, 1942, pp. 417 and 419. In this table figures for world stocks, 1937-41, include carry-over in the Straits Settlements (on lighters and warrants) and carry-over at principal European smelters.
[2] Publication of statistics suspended due to war.

WORLD ASPECTS OF TIN INDUSTRY

WORLD MINE PRODUCTION

World mine production of tin appears to have established a new record in 1941 that exceeded the previous peak in 1940 by 3 percent. Complete official statistics for 1941 are unavailable, but reasonably accurate estimates of totals for the year can be made from the data at hand. Production in the countries participating in the International Control Scheme during 1941 was 4 percent higher than in

1940, whereas that elsewhere was 7 percent lower. The output of the unrestricted producers comprised 10 percent of the total in 1941 compared with 11 percent in 1940, 18 percent in 1939, and 11 percent from 1925 to 1929.

Japan's conquest has shifted the balance of world tin resources. In 1938 the Allies controlled approximately 97 percent and the Axis Powers less than 3 percent of world output, whereas countries under Axis domination in 1942 controlled 66 percent of the 1940 production and those controlled by or accessible to the United Nations 34 percent. Production of tin in 1942 by sources controlled by and available to the United Nations has been tentatively estimated at 90,000 long tons, as follows: Bolivia, 45,000; Nigeria, 15,000; Belgian Congo, 19,000; United Kingdom, 2,500; Australia, 3,500; and others, 5,000 tons.[11] The estimate excludes China because of doubtful access over the Burma Road.

World mine production of tin (content of ore), 1925–29 (average) and 1937–41, by countries, in long tons

[Compiled by B. B. Waldbauer]

Country	1925–29 (average)	1937	1938	1939	1940	1941
Restricted production:						
Belgian Congo	967	8,084	8,820	9,663	12,392	[1] 14,445
Bolivia [2]	37,169	25,128	25,484	27,211	37,940	42,199
Indochina	691	1,577	1,599	1,470	2,098	[1] 1,430
Malay States						
Federated	54,606	75,117	41,206	49,525	85,384	[1] 78,000
Unfederated	2,206	2,075	2,041	1,994		
Straits Settlements	25	72	114	206		
Netherlands Indies	33,266	39,133	27,299	27,755	43,193	[1] 51,000
Nigeria	8,319	10,782	8,977	9,427	12,012	[1] 15,000
Thailand (Siam)	8,204	15,786	14,704	[5] 17,325	17,447	[1] 16,250
Total signatory countries	145,453	177,754	130,244	144,576	210,466	218,324
Unrestricted production:						
Argentina	32	1,423	1,886	1,655	1,481	921
Australia	2,830	3,256	3,329	3,500	(3)	(3)
Burma	2,228	7,472	7,100	8,536	[1] 5,500	(3)
Cameroun, French	------	231	242	255	(3)	(3)
China [2]	7,085	12,871	11,605	10,422	6,249	(3)
Germany	98	[1] 100	[1] 300	[1] 300	(3)	(3)
Italy	------	131	271	229	(3)	(3)
Japan	625	2,175	2,186	[1] 1,700	(3)	(3)
Mexico	2	373	249	289	345	212
Morocco, French	4	14	27	(3)	(3)	(3)
Peru	------	173	103	47	72	45
Portugal [4]	625	1,095	1,037	1,486	1,721	2,261
Portuguese East Africa	5	6	4	7	8	(3)
Rhodesia:						
Northern	------	5	3	------	(3)	(3)
Southern	15	139	267	451	(3)	(3)
Somaliland, Italian	------	------	------	[1] 40	(3)	(3)
South-West Africa	149	169	164	156	137	120
Spain	145	127	110	(3)	91	[5] 50
Swaziland	138	108	122	114	103	(3)
Tanganyika	22	243	241	229	258	(3)
Uganda	98	361	399	346	(3)	(3)
Union of South Africa	1,174	537	558	482	518	[6] 398
United Kingdom [4]	2,658	1,987	1,999	1,630	1,560	[1] 1,600
United States	24	168	95	34	49	63
Total nonsignatory countries	17,957	33,164	32,297	32,100	25,100	23,300
Grand total	163,000	211,000	163,000	177,000	236,000	242,000

[1] Estimates derived in part from American Bureau of Metal Statistics and Engineering and Mining Journal.
[2] Exports.
[3] Estimate included in the total.
[4] Restricted production basis from 1934–36, inclusive.
[5] January to October, inclusive.
[6] January to November, inclusive.

[11] Tin, Future Tin Supplies: February 1942, p. 1.

WORLD SMELTER PRODUCTION

The large tin-smelting plants of the Straits Settlements and those of Netherlands Indies have been destroyed or put out of commission, as they have fallen into enemy hands. Nevertheless, during the greater part of 1941 these plants operated at a very high rate. The smelter at Penang stopped accepting ore only shortly before December 19, when the island was captured by the Japanese. At Singapore, smelting was slowed in December as shipments of concentrates from mines came to a standstill, and by the end of January 1942 it was reported that only clean-up work was being done. It is understood that by the time Singapore surrendered all tin at Palau Brani where the plant was situated had been sent away. Presumably smelting continued throughout the year on the island of Banka and did not cease until the early part of February 1942. Ores and concentrates continued to flow to the United Kingdom from Nigeria and Bolivia. Smelter capacity has been expanded in the Belgian Congo. South Africa has resumed smelting operations on a small scale, and in Canada a smelter of low capacity is under construction in British Columbia. Progress was made in constructing the United States Government tin smelter at Texas City so that production of tin was begun in April 1942.

World smelter production of tin, 1925–29 (average) and 1937–41, by countries, in long tons [1]

[Compiled by B B. Waldbauer]

Country [1]	1925–29 (average)	1937	1938	1939	1940	1941
Argentina	----------	734	2,093	1,080	881	768
Australia	2,952	2,907	3,229	3,300	(2)	[3] 5,000
Belgian Congo	----------	2,313	2,283	2,124	7,832	15,000
Belgium [3]	720	[4] 5,500	[4] 6,700	[4] 3,100	(2)	(2)
British Malaya	[5] 88,855	[5] 95,372	[5] 63,746	[5] 81,536	[4] 126,945	[3] 125,000
China	[6] 7,080	11,100	11,200	10,850	22,992	[3] 10,000
Germany [7]	3,444	2,671	3,000	[3] [4] 3,600	(2)	(2)
Italy	----------	75	271	229	(2)	(2)
Japan	606	1,850	1,900	[3] [4] 2,000	[3] 1,800	(2)
Mexico	(2)	(2)	(2)	90	116	150
Netherlands	[8] 1,000	[3] 26,600	[3] 26,400	[3] 14,600	2,967	(2)
Netherlands Indies [6]	14,749	13,757	7,207	13,941	22,035	[3] 23,000
Norway	(2)	241	254	283	(2)	(2)
Portugal	[9] 2	----------	39	30	781	1,481
Thailand (Siam)	[10] 113	(11)	----------	(2)	(2)	(2)
United Kingdom [3]	45,800	33,800	36,200	37,400	(2)	40,000
	165,000	197,000	163,500	174,100	(2)	(2)

[1] The Union of South Africa resumed smelting operations on a small scale in 1939, 143 long tons were reported for the fiscal year ending July 31, 1941.
[2] Data not available
[3] Estimated.
[4] Yearbook of American Bureau of Metal Statistics.
[5] Exports plus difference between carry-over at end and beginning of year.
[6] Exports.
[7] Includes production of some secondary tin.
[8] Estimated production in 1929.
[9] Average for 1926–27.
[10] Average for 1926–28.
[11] Less than 1 ton.

INTERNATIONAL TIN CONTROL SCHEME

With the close of 1941 the International Tin Control Scheme officially terminated. Although recommendation was made to extend it for another 5 years, the war with Japan prevented any reasonable chance for it to operate, and formal ratification by signatory countries has not been completed. The scheme was initiated

on March 1, 1931, for 3 years. Subsequently it was renewed for 3 years, and again for 5 years to December 31, 1941. The object of the control scheme was to balance production and consumption and prevent rapid and severe oscillations of price by fixing quarterly production quotas, based upon standard tonnages, according to variations in price and stocks. To overcome the time lag which prevented this from being done rapidly enough, so-called buffer stocks of tin were introduced. The first buffer stock, introduced July 10, 1934, and consisting of 8,282 tons, was profitably wound up at the end of 1935. The second stock of 15,000 tons was established July 1, 1938, and was liquidated the latter part of 1939. The scheme also included provisions for research with a view to stimulating tin consumption. The International Tin Research and Development Council was created with research facilities in England and later at the Battelle Memorial Institute, Columbus, Ohio, and with a statistical office at The Hague, Netherlands. In May 1940 the statistical work was transferred to England following the German invasion of the Netherlands. Publication of the statistics ceased at the close of 1941 owing to the war in the Pacific.

The quarterly quotas during 1941 were set at 130 percent of standard tonnage; this would have permitted participants to mine a total of 272,960 tons, virtually full capacity. Unfortunately, this fell short of accomplishment by about 20 percent, and only two countries—Netherlands Indies and Nigeria—could meet their full quotas.

The question of renewal of the control scheme was discussed during 1941. At a meeting of the committee in March, it was announced that a recommendation for continuation of the agreement for a further period from January 1, 1942, had been sent to the signatory governments, subject to certain adjustments. Satisfactory progress was reported at the September meeting, when a preliminary new draft was discussed. Revised standards calculated from actual outputs in the year ended June 30, 1941, were proposed and as announced at the time totaled 231,000 long tons compared with 206,970 tons under the scheme then in effect. Quotas of all participants were raised except those of Bolivia and Thailand, which were lowered. French Indochina was omitted from the list of countries participating. After further discussion, standards for all countries except Thailand were finally revised upward, and a new total was set at 251,400 tons. This was agreed to at a meeting of the committee in London December 1, 1941, and, although Thailand refused to accept, renewal for 5 years was nevertheless recommended. The standard tonnages proposed for the new agreement were:

	Old	*New*
Belgian Congo	15, 035	20, 178
Bolivia	46, 027	46, 768
Malaya	77, 335	95, 474
Netherlands East Indies	39, 055	55, 113
Nigeria	10, 890	15, 367
Thailand	18, 628	18, 500
	206, 970	251, 400

The standard tonnages agreed upon were based on exports from July 1, 1940, to June 30, 1941. The quota for the first quarter of 1942 was fixed at 105 percent, corresponding closely to the 130 percent

of the standard tonnages under the expiring agreement. Owing to the war in the Pacific, the agreement was not formally adopted.

Although the scheme has officially terminated, a framework of the organization has been retained and will continue to function informally.

WORLD CONSUMPTION

Apparent world consumption of tin in 1941 is estimated to have totaled 175,000 long tons—about 3 percent above 1940. Details by countries are unavailable. Estimated 1942 requirements of U. S. S. R. have been given as 15,000 tons and for the British Empire 35,000 tons, of which 25,000 would be for the United Kingdom and the remainder for other components of the Empire.

Apparent tin consumption of the world, 1926–29 (average) and 1936–40, by countries, in long tons [1]

Country	1926–29 (average)	1936	1937	1938	1939	1940 [2]
Belgium	1,231	1,336	1,520	1,618	1,217	900
Canada	2,346	2,164	2,625	2,355	2,601	3,000
Czechoslovakia	1,513	1,684	1,731	1,560	(3)	(3)
France	10,260	9,748	9,175	9,049	8,300	6,000
Germany [4]	12,444	9,164	12,368	13,774	13,000	10,000
India, British	2,704	2,293	2,595	2,494	3,131	3,500
Italy	4,268	3,928	3,601	4,618	4,750	4,000
Japan	4,506	6,403	8,190	10,963	11,184	12,500
Netherlands	980	1,284	1,470	1,400	1,220	1,000
Poland	589	1,322	1,272	1,819	(3)	(3)
Spain	1,565	661	942	1,082	(3)	(3)
Sweden	1,373	1,692	1,889	2,883	2,500	1,500
Switzerland	1,742	1,109	1,100	1,259	1,101	800
United Kingdom	21,988	21,860	25,971	18,290	27,279	32,000
U. S. S. R.	3,791	9,664	25,125	16,174	10,000	8,000
United States	76,539	73,039	86,663	50,724	70,460	76,000
Other countries	15,036	12,549	12,863	11,438	[5] 1,816	(3)
	162,875	159,900	199,100	151,500	166,500	169,500

[1] As estimated by the Tin Research and Development Council.
[2] Metal Bulletin estimate based on figures of Research Institute.
[3] Estimate included in total. [4] Includes Austria, also the Saar, 1936–40.
[5] Denmark and Norway only. Other countries included in total.

REVIEW BY COUNTRIES

Argentina.—Both mine and smelter output of tin in Argentina was considerably less in 1941 than in 1940. According to Ross Field,[12] up to 1940 the Pirquetas lode mine had produced 6,399 metric tons of concentrates containing 1,742 tons of tin. The ore reserves, as of June 30, 1940, amounted to 72,978 dry tons with a tin content of 2,379 tons, which at the present rate of production will last 2½ years. The Pircas Creek placer high-grade gravel is nearly worked out, and plans have been made to work lower-grade dirt, which will prolong the life of the placer at least 4 years, possibly longer. Annual consumption requirements are estimated at 1,100 tons. There is an import duty of 0.27 peso per kilogram of metallic tin.

Australia.—Some of the smaller mines in New South Wales experienced a difficult period in 1941 through prolonged drought. The Ardlethan tin field in New South Wales, which has been of considerable importance, appears to be reaching its final stages. Some tin-

[12] Field, Ross, The Pirquetas Mine, a Tin-Silver Property in Argentina: Eng. and Min. Jour., vol. 142, No. 7, July 1941, pp. 35–39.

mining companies hitherto operating in Malaya are searching for mining properties in Australia. An increase in the price of tin in Australia to £A371 a ton (a rise of £A51 a ton) was announced on April 30 by the Commonwealth Economic Advisor to encourage increased production from low-grade deposits. It is proposed to establish a pool by allocating £A10 a ton for developing low-grade ores. It has been estimated that Australia will produce 3,500 tons of tin in 1942, all of which, it is assumed, will be consumed locally.[13]

Belgian Congo.—The production of tin in the Belgian Congo in 1941 exceeded that in 1940 by about 17 percent and almost equaled smelter capacity (which, according to latest pre-war statistics, was 15,000 tons a year). Some appreciable expansion in output is anticipated during the first 6 months of 1942, as production was to be at the rate of 105 percent of the 20,178 tons permissible annual figure proposed in the unratified control scheme. To increase output, all mining companies have been placed under direct State control. There are three important tin-producing areas—Katanga, Maniema, and Ruanda-Urundi. Tin concentrates are obtained from both lode and placer deposits. The Geomines smelter at Manono treats custom ores as well as company ores. The Symaf tin-mining concern was considering erecting a smelter at its property, but it is not known how far this progressed.

Bolivia.—Owing to Japanese occupation of Malaya, Netherlands Indies, and Thailand, Bolivia is now the principal source of tin for the United Nations. The tin content of ore exported from Bolivia in 1941 was 42,199 long tons compared with 37,940 in 1940. Despite the 11-percent increase, exports were 17,637 tons under the permissible quota of 59,836 tons allowed under the control scheme. About equal portions of the exports went to the United States (for treatment by the new smelter at Texas City) and to Great Britain. Production in 1941 was retarded by labor shortage and lack of railroad transportation from mines to Pacific ports. A standard of 46,768 tons was proposed for Bolivia under the new restriction scheme, which expired at the end of 1941. Production for 1942 has been estimated at 45,000 tons of tin. Few new mines have been discovered recently, and old mines are not being developed. The Director General of Mines of Bolivia has estimated 430,000 tons to be the total supply of tin available in Bolivia. Engineers of the United States Bureau of Mines have been studying the problem of accelerating output and improving the grade of concentrates produced. Most of the low-grade concentrates are shipped by small producers (the large producers include Patino, Hochschild, and Aramayo), who are without means for applying technical knowledge and modern methods to their mining operations. With proper development of their operations, the Director General of Mines predicts that Bolivia should be able to produce about 70,000 tons of tin annually. Recovery in the more efficient mills is 80 percent, while poorer mills obtain 50 percent or less and there are millions of tons of old tailings, mine dumps, and stope fillings assaying 0.6 percent tin or better—in some cases as high as 2 percent. P. H. Reagan states "the recovery of this metal offers an opportunity for the metallurgists who can solve the problem." [14]

[13] Tin (monthly bulletin of The Tin Producers' Association), February 1942, p. 1.
[14] Reagan, P. H., Bolivia. Eng. and Min Jour., vol. 142, No. 8, August 1941, pp. 156–157.

Upon the basis of increases in cost of production, transportation, and insurance, producers campaigned during 1941 for an increase in the price paid them for tin ore. The outcome of this resulted in an amendment to the agreement with Metals Reserve Co. on June 30, 1942, retroactive to January 1, 1942, changing the buying price from 48½ cents f. o. b. U. S. ports to 60 cents f. o. b. Chilean and Peruvian ports and providing for acceptance of concentrates equivalent to 30,000 tons of fine tin a year, suppliable at the option of sellers, in contrast to the 18,000 tons agreed to originally. Although Patino Mines and Enterprises Consolidated does not participate in the Metals Reserve contract it will profit by this new arrangement. Under provisions of a contract with the British Government, the company is entitled to receive settlement upon the basis of the Metals Reserve Co. buying price.

British Malaya.—On December 8 the Japanese invaded Malaya, landing at Kota Bharu airdrome across from the Thailand border in the northern part of the peninsula. Thereafter tin-mining activities were disrupted and ceased entirely as fighting raged toward Singapore. However, the rate of production at tin mines and smelters during the year up to December had been about the same or slightly higher than in the previous year. The 1941 quota for Malaya under the Tin Control Scheme was 100,536 long tons, but up to the end of November only 74,367 tons had been exported. As mine production virtually ceased in December, it has been assumed that total output in 1941 was 78,000 tons or about 9 percent less than in 1940. Ores imported for reduction at smelters in the Straits Settlements from sources other than Malaya during the first 11 months of 1941 totaled 37,293 tons compared with 39,643 tons in the same period of 1940 and 45,576 tons in all of 1940. During the first 10 months of 1941, the smelters shipped 108,855 tons of pig tin, which up to then had been exported at a rate a little above that of the previous year. On December 6 stocks of concentrates at Singapore and Penang are believed to have amounted to the equivalent of 9,975 tons of fine tin, slightly more than half of which was at Penang. Stocks of refined pig tin at Singapore and Penang on July 31 totaled 3,430 tons, of which about 80 percent was at Penang; these had been reduced somewhat, but as of November 30, the carry-over in the Straits Settlements exceeded 2,700 tons, of which about 75 percent was at Penang.[15]

Strict censorship prevailed during the latter part of 1941, and publication of figures relating to mine output was prohibited; but reports indicated almost complete cessation of mining operations toward the end of the year, owing to the Japanese invasion. Shipping difficulties also affected output, and enemy action caused the loss at sea of some mining equipment. With the advance of the Japanese army toward Singapore, shipments of concentrates from the mines ceased. Smelting slowed so that by the end of January 1942 the Singapore smelter was doing clean-up work only. By the time Singapore surrendered on February 15, 1942, all tin at Pulau Brani in Kepple Harbor where the smelter was situated had been sent away. Reliable information on the condition of the smelter (which had been the largest in the world) is not available, but it may have been damaged when the harbor was bombed. The smelter at George Town, Penang, stopped accepting ore only shortly before

[15] American Metal Market: Vol. 48, No. 249, December 30, 1941, p. 5.

the Japanese captured the island on December 19, so that it would seem that some tin fell into the hands of the invaders. Although there is no definite information on the quantity so acquired, reports have stated that 1,500 tons were awaiting shipment at the time, and Japanese statements have indicated that some 1,300 tons were thus obtained. It has not been definitely established whether the George Town smelter was destroyed, although A. Strauss & Co., Ltd., of London reported that it had been. The Japanese, however, have claimed that the smelter and furnaces were intact when they seized the island. The smelter at Butterworth (on the opposite shore of the mainland) was put out of action, according to the British Under Secretary of War.[16] This smelter was only reopened in June 1940 after remaining closed for 9 years during which it served as an ore-buying establishment. Dredges and other mining equipment and power plants were destroyed, however, as the British troops retired; and as long as war continues it will be extremely difficult for the Japanese to re-equip these plants. Some authorities consider that 5 years must elapse before complete recovery of output is possible.[17]

A Commission of Inquiry, appointed in September 1940 by the High Commissioner to investigate the management of the Mines Department of the Federated Malay States, disclosed corruption and bribery. A number of officers of the Mines Department have been prosecuted, convicted, and given prison sentences.[18]

Burma.—The property of Mawchi Mines, Ltd., 20 miles east of Toungoo, which is in territory occupied by the Japanese, is reported to have been put out of commission for at least 18 months before the staff departed.

Canada.—No commercial ore bodies of cassiterite are known in Canada. At present, however, tin is being produced from zinc tailings at the Sullivan mine, British Columbia. Occurrences of tin have been found in New Brunswick, Northwest Territories, Ontario, Manitoba, Yukon, and Nova Scotia. Tin was separated from Sullivan lead-zinc ore some years ago in experimental work by the Consolidated Mining & Smelting Co. of Canada, Ltd. The company, which has continued these experiments from time to time, states in its 1941 annual report that the tin concentration plant commenced operations on March 1, 1941, and functions very satisfactorily. The production of refined tin will commence in April 1942. The tin content of the ore is so small that its recovery is of more academic than commercial importance. * * * A process has been developed for the electric smelting of tin. According to H. R. Banks, superintendent, Sullivan concentrator, "On the basis of present operation the Sullivan production will approach 500 tons of refined tin per year." [19] The smelter is at Kimberley.

China.—No official records of Chinese tin output are available, although this country has been an important producer for centuries. Records have been confined to exports, which have averaged 10,000 long tons annually during recent years. The Minister of Economic Affairs of the Chinese National Government, Chungking, roughly

[16] Mining Journal (London), Demolitions at Penang: Vol. 216, No. 5553, January 24, 1942, p. 43.
[17] Scott, E. Baliol, Tin in 1941, Mining Jour. (London), Ann. Review, No. 1942, April 11, 1942, p. 11.
[18] Mining Journal (London), Malaya. Vol. 215, No. 5548, December 20, 1941, p. 90.
[19] Banks, H. R., Tin at the Sullivan Concentrator. Proc. Ann. Meeting, B. C. Division, Canadian Inst. Min. and Met., October 10, 1941, Canadian Min. and Met. Bull. 356, December 1941, Trans., vol. 44, 1941, pp. 611-622.

estimates that 17,278 metric tons of tin were produced in 1940 in unoccupied China.[20]

Nearly all the ore produced is smelted in China, although during the last 5 or 6 years small tonnages were being shipped to smelters in the Straits Settlements. Pig-tin imports have not been large, and very little is known about the quantity consumed. Since 1937 exports have declined steadily. Tin is a Government monopoly, and exports are controlled through the Yunnan Consolidated Tin Corporation and the National Resources Commission. The Government has been striving for an annual export of 15,000 tons of tin. Yunnan, Kwangsi, and Hunan Provinces are the principal sources, the bulk of the output coming from Yunnan. Estimates of production in Yunnan during the first quarter of 1941 were 1,352 tons, with stocks of about 7,000 tons on hand. Approximately 2,400 tons of pig tin were shipped to the United States via the Burma Road during the first 9 months of 1941.

A Chino-Russian barter agreement provides for repayment of Russian credits with shipments of tin and other materials from China to Russia. The United States, through the Metals Reserve Co., has arranged to purchase wolframite, antimony, and tin from the National Resources Commission of China to the total value of $90,000,000, but no tin had been received by Metals Reserve Co. for stock-piling up to the end of 1941.

Germany.—There are no important tin mines in Europe, and Germany formerly depended entirely on imports from the Far East and Bolivia for her requirements. Germany is believed to have had large stocks in 1938 and to have acquired additional stocks in the Netherlands. Substitutes have been developed for many uses, such as in the food-packing industries, and all available tin is reserved for highly essential applications. Germany has been outstanding in the reclamation of scrap tin and other metals for many years. Substantial amounts of cadmium, a substitute in some uses of tin, are produced in Germany and Poland. Despite these efforts to eke out a tin supply, some authorities assert that Germany is facing a critical tin shortage. According to Tin,[21] the official bulletin of the Tin Producers' Association—

> Germany's tin reserves must be fast diminishing. Her shipbuilding, aircraft building, and armaments program for 1939 and 1940, if it were as extensive as neutral observers would have us believe, must have almost exhausted Germany's reserves of tin. Whichever way one may approach the problem it becomes clearly evident that the tin shortage must be assuming alarming proportions in Germany. How long she can go on without tin, or whether she has successfully exploited a substitute are matters upon which it is naturally impossible to offer any concrete facts. Submarines, ships, aircraft, tanks, guns—all these things are virtually impossible without tin. Germany cannot go on producing war weapons unless she gets stocks of tin. Is she getting those stocks? From all statistics and information available it would seem that she is not. In fact, it would appear that Germany is now facing a severe shortage of tin. If this is so it is almost certain that we shall once again see a deterioration in her aircraft production, in her shipbuilding program, and, what is more important, in her fire power, both in bombs and shells. Experts talk glibly of Germany's shortage of oil and the effects of the food blockade, but the tin shortage may do more to sabotage Germany's war effort than either of them.

[20] Smith, A. Viola, Mineral Resources, Production and Trade of China: Bureau of Mines, Foreign Minerals Quarterly, vol. 4, No. 2, October 1941, p. 7.
[21] Tin, Tin and Germany's War Effort: April 1941, p. 4.

Italy.—The tin resources of Italy are insignificant compared with requirements. It is reported that all tin-bearing equipment in public bars and restaurants has been requisitioned by the Government.

Japan.—On August 1, 1942, Japan possessed sources formerly supplying two-thirds of the world's tin, as a result of military operations begun with its attack on Pearl Harbor, December 7, 1941. The annual demand for tin in Japan in peace time was about 4,400 tons, of which 20 percent was supplied from its own mines and the remainder imported. Japan is believed to have accumulated a stock pile of tin before hostilities began, but war needs have probably increased to 12,000 to 15,000 tons a year, of which only about 5,000 tons can be supplied by Japanese smelting facilities. Therefore, unless the smelters in the Straits Settlements and Banka can be operated, Japan will be somewhat handicapped until its own smelting capacity has been increased. Ample ore is available in Thailand and Indochina to meet Japanese requirements. It has been reported that the refineries at Penang, Singapore, and Banka are to be operated by Mitsubishi Mining Co. and the Togo Mining Co.

Mexico.—The small quantity of tin produced annually in Mexico is obtained by native miners, chiefly from scattered deposits. A refinery of small capacity at San Luis Potosi produces pig tin, all of which is consumed in Mexico. Ores that cannot be treated in Mexico are sold for export. The Metals Reserve Co. has contracted for the purchase of 3,630 tons of tin concentrates from Mexico. By Presidential decree, effective July 15, 1941, exportation of tin from Mexico to any non-American country is prohibited. Tin deposits of Mexico recently have been investigated by the United States Geological Survey. The problem of concentrating low-grade tin ores is being studied with a view to establishing a central treating plant at Aguascalientes.

Netherlands Indies.—The permissible export quota of Netherlands Indies for 1941 was 50,772 long tons; up through November, 48,805 tons had been exported and as additional quantities were doubtless shipped during December the total for 1941 has been estimated at 51,000 tons, or about 18 percent more than in 1941. Production and smelting operations presumably continued up to the end of January 1942 or shortly before Japanese planes came over Banka on February 3. Japanese troops landed on the west coast of Billiton on April 10, 1942, according to a broadcast from Tokyo. The smelters on Banka were at Muntok, Pangkalpinang, and Belinjoe. It is believed the smelting plants were destroyed and all dredges with their machinery sunk to prevent them from falling into Japanese hands. Ores imported into the United States from Netherlands Indies during the latter part of 1941 contained 6,220 tons of tin. The Billiton Co. and the Netherlands Government contracted with the Metals Reserve Co. for the shipment of tin concentrates at the rate of about 2,500 tons (equivalent to 1,875 tons of refined tin) monthly, starting with July. Under the agreement Metals Reserve Co. was to acquire tin concentrates containing 20,000 tons of fine tin to be converted at the Texas City smelter upon the basis of 50 cents per pound, less smelting charges and penalties for impurities.

Nigeria.—Tin mining was greatly accelerated in Nigeria during 1941; consequently, production no doubt reached an all-time peak. The output for the year is estimated at 15,000 long tons of tin. Exports had exceeded 13,200 tons by October; statistics for November

and December are not available. The 5-year contracts between Nigerian producers and English smelters expired during 1941. Owing to the war, new contracts were made for 1 year only at increased rates. The International Tin Committee proposed 15,367 tons as the standard for Nigeria in the new unratified 1942 restriction scheme, with a permissible production quota of 105 percent thereof for the first 6 months of 1942. Estimates indicate a total production of 15,000 tons in 1942. The provisions of the Lend-Lease Act have been made available to mining companies of Nigeria to augment facilities for increasing output. Nigeria is at present the chief source of supply for tin within the British Empire.

Union of South Africa.—The Zaaiplaats Tin Mining Co., Transvaal, which resumed operation of its small reverberatory furnace in 1939, has expanded smelting facilities so as to treat concentrates from Northern Rhodesia, Mozambique, and Swaziland. The output so far has not been large, but during the fiscal year ended July 31, 1941, the company produced 143 long tons of ingot tin compared with 57 tons in the previous year. This establishment operated a smelter during the First World War and sold the metal locally, chiefly to South African railway companies. During recent years, production in the Union of South Africa has averaged 900 tons of concentrates containing 54 percent to 68 percent metallic tin annually.

United Kingdom.—Tin consumption in 1941 amounted to 30,000 long tons compared with 29,225 tons in 1940. Every effort is being made to restrict consumption to 25,000 tons in 1942. Stocks of tin in official warehouses on December 8, the last date information was issued, were 6,517 tons. Deliveries of pig tin during the first 6 months of 1941 amounted to 5,366 tons. Imports of ore from Bolivia and Nigeria apparently were higher than in 1940 and ore receipts for smelting probably were more than adequate to meet requirements. In recent years smelter output has averaged 34,700 tons of tin annually, and doubtless could be greatly expanded as production rose to 55,200 tons in 1929. The Cornwall mines produced 1,600 tons of tin, slightly more than in 1940. As part of a Government drive to increase production of Cornish tin, the Ministry of Supply has agreed to bear all risks and costs necessary to increase output. The tin-mining industry has received "essential works" status so that workers can neither be dismissed nor leave without plausible explanation, and working conditions are guaranteed.

The London tin market has been closed since December 8, 1941. The Government has assumed control of tin prices, industrial stocks, international purchases, and sales. Tin and various alloys containing tin require license for export. Acquisitions of tin, scrap, ore, concentrates, and residues are subject to license. On February 16, 1942, the price of grade A tin, delivered buyers' premises, was fixed at £275 a ton.

U. S. S. R.—Although tin deposits are known in several districts of the Soviet Union, none appears to be capable of extensive development, and only small quantities of tin seem to have been produced there. The Soviet tin demand is therefore accurately measured by its imports, and these indicate a remarkably rapid increase in consumption during recent years. Imports are not available beyond 1937, but information gathered from the trade returns of exporting countries (Netherlands, Great Britain, Belgium, etc.) indicates that

shipments to Russia during 1937 and 1938 averaged 20,650 tons a year. Russia probably entered the war with a substantial reserve stock, but its active buying in August 1941 suggests that tin may have become scarce at that time. Under a barter agreement with China, four Russian credits (since 1938 totaling between $200,000,000 and $250,000,000), with repayment in 5 to 10 years, have been made against shipments of tin and other materials from China to Russia.

An Anglo-Soviet trade pact signed in Moscow on August 16 provided, among other things, for furnishing supplies of tin to Russia by Great Britain. Soon thereafter Russia began buying Straits tin in the East and probably could obtain shipments totaling as much as 9,000 tons. Additional quantities are believed to have been purchased for forward delivery, but it is not known whether British merchants have been able to cover these commitments.

ARSENIC AND BISMUTH

By HERBERT A. FRANKE [1]

SUMMARY OUTLINE

ARSENIC

SUMMARY

Domestic production of white arsenic in 1941 exceeded all previous records and increased 30 percent over that of 1940. Consumption also reached a new peak and exceeded that of 1940 by 28 percent. Demand for white arsenic was so great that producers' stocks neared exhaustion in the fall of 1941. A shortage of arsenic is forecast for 1943 unless production facilities are expanded because of the increased insecticide, military, and other requirements in 1942 and 1943. On May 22, 1942, arsenic was put under allocation control. Quotations on domestic white arsenic advanced from 3½ cents to 4 cents a pound in August 1941.

Salient statistics for arsenic in the United States, 1925–29 (average) and 1938–41

	1925–29 (average)	1938	1939	1940	1941
WHITE ARSENIC					
Domestic sales [1]					
Crude ..... short tons	2,364	9,428	17,070	16,688	28,661
Refined ..... do	10,035	3,732	5,369	6,651	6,123
Imports for consumption ..... do	10,769	14,238	14,674	9,929	[2] 7,578
Apparent consumption [3] ..... do	[4]	25,098	33,913	31,668	[5] 40,442
Average value for domestic sales [1]					
Crude ..... cents per pound	2.69	1.40	1.00	1.10	1.47
Refined ..... do	3.57	1.73	1.42	1.47	2.24
OTHER ARSENICALS					
Imports for consumption					
Metallic arsenic ..... pounds	208,672	16,868	39,197	13,228	[2] 2,240
Sulfide (orpiment and realgar) ..... do	575,506	241,602	656,498	220,445	[2] 11,025
Arsenic acid (H_3AsO_4) ..... do	14,692	55	210	-----	-----
Calcium arsenate ..... do	1,452	400,000	1,627,193	432,785	[2] 1,230,960
Lead arsenate ..... do	[6] 2,133	-----	11,557	-----	-----
Sheep dip ..... do	135,929	168,932	306,900	341,556	[2] 264,200
Paris green and london purple ..... do	4,402	103,556	45,823	25,603	[2] 4,000
Sodium arsenate ..... do	82,105	11,881	7,482	-----	-----
Exports					
Calcium arsenate ..... do	[7] 2,159,168	5,242,882	6,731,103	4,879,391	[2] 2,675,097
Lead arsenate ..... do	[7] 1,328,828	1,021,345	1,712,583	2,900,250	[2] 3,749,115

[1] Includes sales by domestic producers for export
[2] Figures cover 9 months only, data for last quarter of the year are confidential.
[3] Adjusted for exports by domestic producers.
[4] Complete data not available.
[5] Actual consumption
[6] 10,467 pounds in 1925 and 200 pounds in 1929, no imports from 1926 to 1928, inclusive.
[7] Average for 1928–29, exports of calcium arsenate and lead arsenate not separately recorded by the Department of Commerce prior to 1928.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

World production of new arsenic, which probably set a record, was substantially controlled by the Allies, but because it controlled the output and stocks in Sweden, plus its own production, the Axis had the greatest supplies available.

PRODUCTION

Domestic smelters and refineries operated their roasting and subliming facilities at virtually maximum capacity in 1941 to produce 32,481 short tons of white arsenic. Producers of marketable arsenic included the American Smelting & Refining Co., Anaconda Copper Mining Co., and U. S. Smelting, Refining & Mining Co. which derived their product from baghouse and Cottrell dust, speiss, and accumulated smelter-refinery byproduct residues. Of the production, 83 percent consisted of crude (black) arsenic and 17 percent of refined arsenic.

Crude and refined white arsenic produced and sold by producers in the United States, 1937–41

Year	Crude			Refined			Total		
	Production (short tons)	Sales		Production (short tons)	Sales		Production (short tons)	Sales	
		Short tons	Value [1]		Short tons	Value [1]		Short tons	Value [1]
1937	9,936	10,903	$290,733	6,878	6,733	$250,822	16,814	17,636	$541,555
1938	12,619	9,428	264,004	4,066	3,732	129,018	16,685	13,160	393,022
1939	17,499	17,070	343,000	4,842	5,369	152,500	22,341	22,439	495,500
1940	18,241	16,688	365,700	6,742	6,651	195,600	24,983	23,339	561,300
1941	26,843	28,661	844,793	5,638	6,123	274,527	32,481	34,784	1,119,320

[1] Partly estimated

Production, as reported by the Bureau of Mines, is measured after the low-grade flue dusts containing 20 to 60 percent As_2O_3 are subjected to a roasting or preliminary refining process. This crude arsenic usually contains 93 to 98+ percent As_2O_3. Most of the crude arsenic and a small quantity of better-grade arsenic obtained in certain parts of smelter flue systems are marketed without further refining. Some crude arsenic is refined further. Bureau of Mines statistics on refined arsenic include only products containing 99 percent or more As_2O_3. The arsenic reported as a refined product is not duplicated in the crude arsenic statistics.

It is anticipated that the record 1941 output will be duplicated in 1942. All accumulated arsenic residues in the United States, however, were consumed in 1940 and 1941, and producers will depend largely on current accelerated byproduct recoveries. The American Smelting & Refining Co. has some surplus stock of residue available at San Luis Potosi, Mexico, and is treating it at its El Paso (Tex.) plant. Getchell Mine, Inc., Red House, Nev., installed a Cottrell electrical precipitator unit, two 260- by 7½-foot rotary kilns, and other equipment in 1941 and will become a new producer in 1942, recovering the arsenic by roasting gold ore (which contains arsenopyrite, orpiment, and realgar) before cyanidation.[2] In 1941 the com-

[2] Wise, Fred, Roasting Improves Gold Recovery at Getchell Mine: Min. Cong. Jour., vol. 28, No. 4, April 1942, pp. 48–51.

pany produced a substantial quantity of crude arsenic and made a few small trial shipments of the low-grade material.

Although smelter-refinery facilities have been extended, requirements in 1942 are expected to be much greater than future byproduct production, and it appears that present producing facilities must be substantially expanded. Arsenical ore reserves of the Western States are abundant. In World War I, when a shortage of arsenic developed owing partly to war conditions but mainly to the demand among farmers who had been instructed regarding the merits of arsenical insecticides, several new enterprises were started in the West. A substantial quantity of arsenic was produced from an operation at Gold Hill, Utah. The Jardine Mining Co., Jardine, Mont., which ceased byproduct arsenic production at its gold-mining property in 1936, still possesses its arsenic recovery equipment and has arsenic values in its gold-tungsten ore.

The Anaconda Copper Mining Co. continued to be the sole domestic producer of metallic arsenic in 1941 and increased its output 25 percent over that in 1940. The Rare Metal Products Co., Belleville, N. J., as before, was the only domestic producer of commercial arsenic sulfides.

CONSUMPTION

Data on actual consumption in 1941 were obtained by the Bureau of Mines in a special consumer survey conducted at the request of the War Production Board. Results of the survey are being withheld at the request of the War agencies.

In 1941 calcium arsenate was used chiefly to combat the cotton boll-weevil, leaf-worm, and boll-worm infestations in the South, where the situation became so serious that a local shortage of calcium arsenate developed for a time during the summer. Lead arsenate was employed largely as a spray on apple and pear trees, to exterminate codling and gypsy moths, and to treat soil in the East in destroying the Japanese-beetle grub. The carry-over of calcium and lead arsenate in the hands of suppliers at the end of 1941 was approximately 4,300,000 and 11,250,000 pounds, respectively, compared with about 25,000,000 and 10,000,000 pounds at the close of the 1940 season. Total consumption of calcium and lead arsenate in 1942 is estimated at 45,000,000 and 60,000,000 pounds, respectively. Heavy boll-weevil infestation in the Southeastern Cotton States is predicted where a heavy demand is anticipated for calcium arsenate and molasses as a poison mixture. Other arsenical insecticides were used in 1941 chiefly on truck farms. Federal and State agencies employed considerably less arsenic in fighting grasshoppers, Mormon crickets, and white-fringed beetles in 1941 than in previous years, although Congress appropriated $2,225,000 to the Bureau of Entomology and Plant Quarantine for the control of destructive pests. The Department of Agriculture reports that in 1941 these agencies consumed 210,000 gallons of liquid sodium arsenite for grasshopper bait (75,000 gallons estimated for 1942), 151,000 pounds of calcium arsenate for mole crickets in Florida, and 378,658 pounds of calcium arsenate and 54,232 gallons of liquid sodium arsenite in destroying white-fringed beetles (351,500 pounds and 25,000 gallons estimated for 1942). Sodium fluosilicate largely replaced sodium arsenite to combat grasshoppers

and Mormon crickets and will replace calcium arsenate in fighting the mole cricket in 1942.

There was a tendency in 1941 to substitute arsenic for other poisonous insecticide and rodent constituents because of the difficulty in procuring squill, thallium sulfate, and rotenone (derived from imported derris, cube, and barbasco roots). Loss of the Netherlands Indies and Malaya to Japan cut off a big part of the supply of rotenone-bearing roots, and on April 14, 1942, Conservation Order M-133 limited the use of rotenone poison, which now must come from Latin America. Pyrethrum, however, offers a satisfactory substitute for some insecticidal uses, it is available from Africa, and the flower can be grown in the United States. The use of sodium arsenite as a weed killer rose in 1941 because of the shortage of sodium chlorate and the shift of labor from weed control to more essential work.

Restrictions on the use of tin in cans resulted in the manufacture of more glass containers in 1941, the production of which is expected to greatly increase in 1942 and 1943. Not only does arsenic go into the manufacture of glass containers but also into the making of heat-resisting oven and top-of-stove glassware, electric light bulbs, optical glass lenses, bottles, building, plate, scientific, flat, and other machine and handmade glassware. It is said that the use of arsenic is not absolutely essential as a decolorizer, opacifier, and refining agent for most glass, but the procurement of some substitute materials probably will be difficult. Arsenic consumed by the glass industry in 1941 is estimated to have advanced about 40 percent over that in 1940. Arsenical compounds were used in the treatment of syphilis and other diseases in 1941. There was a marked increase in the sale of arsenic medicinal compounds, chiefly the arsphenamines. A large part of this increased demand went to meet requirements of the armed services, Lend-Lease, and exports. White arsenic was consumed in the manufacture of arsenic acid used in the preparation of insecticides, dyes, and other products. Arsenic wood preservative paste and arsenic in other forms were employed in preserving telephone and fence posts, Celotex cane-fiber insulating board, railroad ties, mine timber, piles, etc. White arsenic and metallic arsenic (made from white arsenic) had limited metallurgical applications in the manufacture of antimonial lead and lead anodes and as a flux or alloying element in copper, brass, white bearing metal, and other alloys. Miscellaneous uses for white arsenic included antifouling paint for ship bottoms (in place of mercury) and the purification of producer gas by the Thylox method.

In view of the tremendously increased insecticide, glass, military, and Lend-Lease requirements, it was considered prudent to begin conserving domestic supplies of arsenic, and on May 22, 1942, it was placed under allocation control by General Preference Order M-152. No producer or distributor of arsenic can make delivery to any person unless he has received specific authorization from the Director of Industry Operations, who controls the quantity of arsenic that a supplier can deliver to any person and the purpose for which it may be used. On July 11, 1942, an amendment to the order covered the procedure by which small consumers could place purchase orders for arsenic. The use of arsenic probably will be greatly restricted in glass, weed killer, and certain insecticides.

On May 18, 1942, the Office of Price Administration issued a maximum price regulation (No. 144) on all household and agricultural insecticides (seasonal commodities). On October 1, 1941, the United States Department of Agriculture revised the Insecticide Act of 1910 providing for proper labeling, declaration of imports, and inspection of insecticides and fungicides.

The Public Health Service reported that manufacturers and distributors sold 18,211,074 doses of arsenical drugs for treatment of syphilis in 1941 compared with only 13,371,490 in 1940. The 5-day arsenic drip method for treatment of incipient cases of syphilis was used in hospitals in Chicago, where an active campaign was waged against venereal disease.

PRICES

Eastern quotations on domestic refined white arsenic, packed in barrels, carlots, rose from 3½ to 4 cents a pound in August 1941. Less than carlot deliveries advanced from 4¼ to 4¾ cents. The actual average selling value for domestic sales in 1941 was only 1.47 cents a pound for crude and 2.24 cents for refined arsenic—an increase of 34 and 52 percent, respectively, over that in 1940. Despite the limited supply of white arsenic, quotations on arsenical compounds were affected only slightly in 1941. Minimum prices for calcium arsenate remained unchanged at 6½ cents a pound during 1941, although there was a slight upward tendency in August, and in February 1942 the price advanced to 7 cents. Some sellers reduced prices on lead arsenate from 9½ cents to 9 cents in January 1941, but later in May and August quotations ranged at higher levels. No quotations were published on arsenic metal, and it is assumed that the nominal price remained at about 75 cents a pound.

Range of quotations on arsenic and its compounds at New York (or delivered in East), 1940–41, in cents per pound [1]

	1940	1941
Arsenic metal, lump, cases	(2)	(2)
White arsenic (As_2O_3), domestic, kegs, carlots	3 00– 3 50	3.50– 4.00
Red arsenic (As_2S_2), imported, cases	17 50–18 00	(2)
Calcium arsenate, wholesale, drums, carlots	6.00– 7 25	6.50– 7 50
Lead arsenate, wholesale, drums, carlots	8 50–11 00	9 00–11.00
Sodium arsenate, wholesale, drums	7 00– 8.00	7 00– 8.00
Sodium arsenite, dry, works, drums: white	8 00– 8.75	7 25– 9.00
Sodium arsenite, dry, works, drums: gray	6 50– 7 50	6 25– 7.50

[1] As reported by Oil, Paint and Drug Reporter.
[2] Not quoted.

FOREIGN TRADE

Compared with imports of white arsenic during the first 9 months of 1940 (8,665 tons), imports of white arsenic decreased 13 percent during the 1941 period. Of the 1941 imports, Mexico supplied 88 percent, Canada 9 percent, and Japan 3 percent. Unofficial export data obtained from private sources show that 2,154 tons of white arsenic were shipped abroad in 1941 compared with 1,600 tons in 1940.

Data on the foreign trade in arsenical compounds during the first 9 months of 1941 are given in the table on salient statistics. There was a substantial drop in imports of all arsenical compounds except calcium arsenate, which increased. Metallic arsenic was imported

from the United Kingdom, arsenic sulfide from France, calcium arsenate from Canada, sheep dip from the United Kingdom, and paris green and london purple from the United Kingdom. Exports of calcium and lead arsenate went chiefly to former countries of destination.

White arsenic imported for consumption in the United States, 1937–41, by countries

Country	1937		1938		1939		1940		1941 (Jan.–Sept.)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium	708	$20,373	565	$16,100	323	$10,098	15	$1,152	-------	-------
Canada	599	48,896	689	29,854	471	24,760	339	18,016	707	$42,101
France	828	18,838	1,176	30,843	2,200	50,224	1,654	25,799	-------	-------
Germany	7	663	112	5,656	(1)	4	-------	-------	-------	-------
Japan	798	37,380	482	17,199	963	30,079	224	10,307	193	10,668
Mexico	11,500	556,097	8,422	415,180	8,124	377,568	7,520	393,413	6,678	375,246
Norway	-------	-------	-------	-------	-------	-------	1	187	-------	-------
Sweden	4,816	138,617	2,792	93,197	2,593	69,304	176	4,156	-------	-------
	19,256	820,864	14,238	608,029	14,674	562,037	9,929	453,030	7,578	428,015

[1] Less than 1 ton

TECHNOLOGIC DEVELOPMENTS

Recovery of arsenious oxide in relatively pure form from metallurgical dusts is claimed by Archibald in United States Patent 2,257,710, which comprises a froth-flotation treatment involving the use of a water and kerosene reagent. Patent 2,257,746 relates to a process for electrolytically oxidizing a water soluble arsenite to the corresponding arsenate, and Patent 2,263,594 concerns the manufacture of cupric meta-arsenite by treating white arsenic and copper with an ammonium chloride solution. By proper control of composition and conditions, iron oxide and tin oxide ores can be dearsenized before reduction begins.[3] A new lead-base bearing alloy developed contains 3 percent arsenic which has, at elevated temperatures, the tensile strength and Brinell hardness equal to tin-base alloys and in general, properties superior to the lead-base and tin-base bearing alloys now in use.[4]

WORLD PRODUCTION AND CONSUMPTION

Tremendous war demands for nonferrous metals in 1941 greatly increased smelter and refinery byproduct production of arsenic. It is not unreasonable to believe that world production of marketable white arsenic exceeded 80,000 tons. Output increased 39 percent in Mexico, 30 percent in the United States, and 11 percent in Brazil, the only countries on which official data are available.

Inasmuch as Sweden is virtually under Axis domination, Germany has available the world's largest source of arsenic—the mines and storage silos of Bolidens Gruv A.-B. The large concrete storage silos at Rönnskar were extended in 1934 to hold 250,000 tons of arsenic, and in 1939 additional storage capacity was added. Germany, France, Greece, Belgium, Italy, Japan, Portugal, and Hungary also are producers of arsenic.

[3] Klärding, Josef (Dearsenizing Oxide Ores): Archiv Eisenhütten. (Germany), vol. 14, 1941, pp. 473–476.
[4] Phillips, A. J., Smith, A. A., and Beck, P. A., The Properties of Certain Lead-Bearing Alloys: Am. Soc. Test. Materials, vol. 41, 1941 (preprint, 8 pp.).

World production of white arsenic, 1936–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1936	1937	1938	1939	1940	1941
Australia:						
New South Wales	124	--------	--------	(2)	(2)	(2)
Western Australia	3,526	2,087	4,063	1,439	3,385	(2)
Belgium-Luxemburg (exports)	2,731	3,039	2,706	3,332	(2)	(2)
Brazil	732	717	519	713	1,088	1,203
Canada	619	630	987	790	950	(2)
China	(3)	(2)	(2)	(2)	800	(2)
Chosen	230	--------	(2)	(2)	(2)	(2)
France	9,750	6,501	(2)	(2)	(2)	(2)
Germany (exports)	2,739	2,852	2,845	(2)	(2)	(2)
Greece	85	234	77	113	(2)	(2)
Hungary	--------	100	(2)	(2)	(2)	(2)
Italy	--------	--------	810	(2)	(2)	(2)
Japan	2,629	(2)	(2)	(2)	(2)	(2)
Mexico	8,527	10,762	8,894	7,063	9,268	12,844
Portugal	150	112	1	(2)	(2)	(2)
Rumania	--------	6	3	(2)	(2)	(2)
Southern Rhodesia	--------	--------	19	--------	(2)	(2)
Sweden (sales) [4]	8,647	(2)	(2)	(2)	(2)	(2)
United Kingdom	155	97	66	(2)	(2)	(2)
United States	13,952	15,253	15,136	20,267	22,664	29,466
	55,700	(2)	(2)	(2)	(2)	(2)

[1] Arsenic is also believed to be produced in Czechoslovakia, Iran, Peru, Turkey, and U. S. S. R. Production figures are not available for these countries.
[2] Data not available.
[3] Data not available. Estimate included in total.
[4] Arsenic content of ores mined is as follows: 1936, 23,312 tons; 1937, 20,954 tons; 1938, 21,480 tons; data not available for later years.

Argentina.—Mexico has replaced Sweden as the source of 1,000 to 1,200 tons of white arsenic required annually for sheep dip and the treatment of hides and skins. In addition, about 9,000 tons of ready-made sheep dip are imported annually.

Brazil.—Of 1,203 metric tons of arsenic produced in 1941, the São João D'el Rey Gold Mining Co. contributed 1,110 tons, Companhia Minas da Passagem 88, and Companhia Brasileira de Mineração 5. The Companhia Minas da Passagem discontinued production during the year. Arsenic may be produced at another property, the São Bento mine. The importation of lead arsenate (for cotton crop) is understood to have been very heavy in 1941.

Bolivia.—Calcium arsenate is expected to be recovered as a by-product in the processing of Bolivian tin ores by the Tainton smelting process.

Canada.—Canadian output of arsenic probably was increased substantially in 1941 by the Deloro Smelting & Refining Co., Ltd., which formerly produced at the rate of about 1,000 tons annually from silver-cobalt-arsenic ores of Cobalt, Ontario. Arsenic residue stock-piled for several years by the O'Brien and Beattie [5] gold mines was marketed, and a contract was let for all future output. Demand reached the point where gold-bearing arsenopyrite ores of the Little Long Lac, Hard Rock, MacLeod-Cockshutt, and other mines in Ontario and Quebec and of the Bralorne and Hedley mines in British Columbia were being considered for their arsenic values.

Chile.—Estimated annual arsenical requirements are 250 tons of lead arsenate, 50 tons of calcium arsenate, and some white arsenic for sheep dip.

[5] Archibald, S. R., Martin, S. J., and Koenen, A. T., Roasting of Beattie Concentrate: Trans. Canadian Inst. Min. and Met., vol. 42, 1939, pp. 608–631.

China.—In 1940 China produced an estimated 800 metric tons of white arsenic and 400 tons of realgar, of which 46.8 tons and 35.7 tons, respectively, were exported.

Mexico.—Arsenic roasting and subliming plants at San Luis Potosi and Torreón operated near peak capacity in 1941. Of 12,590 metric tons of arsenic exported in 1941, 10,101 tons were destined to the United States, 1,706 to the United Kingdom, 532 to Argentina, and 251 to the Union of South Africa.

Peru.—Calcium arsenate was imported from the United States to combat the cotton boll weevil, and some arsenic was received for the preparation of sheep dip. The Cerro de Pasco Copper Corporation has accumulated substantial quantities of arsenical residue and is considering the production of white arsenic.

Spain.—Arsenic and manufactured arsenical compounds, hitherto more economically available from other countries, are being produced in Spain. The Fabrica de Arsenico, Mineras de Arsenico, and the Sociedad Industrias Arsenicales Reunidas are mining and treating mispickel ore from 13 pocket deposits in the northwestern part of Spain. The ore contains 25 to 34 percent arsenic and is mined solely for its arsenic content.[6]

United Kingdom.—Metallic arsenic is marketed by the Metallo Refining Co. Ltd., and it enjoys a steady demand at £325 per long ton. Early in 1942 an association of importer-distributors was formed to handle all sales of foreign white arsenic, which was quoted at £40 per ton, 99+ percent As_2O_3, for lots of 20 tons or over, delivered. Early in 1941 and in the summer of the year quotations for refined white, in warehouse, were only £30 and £33 10s. per ton.

Uruguay.—Annual white arsenic consumption totals approximately 1,000 tons—for cattle and sheep dip, insecticides, and weed killer—which are distributed by the Institute of Industrial Chemistry and Department of Agriculture.

BISMUTH

SUMMARY

Although the Bureau of Mines is not at liberty to publish domestic statistics on production it can be reported that the bismuth output in 1941 surpassed the record output of 1940, largely owing to the treatment of some accumulated rich bismuth residues. Apparent consumption increased about 100 percent over that in 1940. Army and Navy medical units and South American countries increased their purchases of pharmaceuticals containing bismuth, and the aircraft, munitions, machine-tool, building, and other industries consumed much larger quantities of bismuth alloy. Despite the slight increase in production and the doubling of consumption, domestic stocks rose substantially owing to increased receipts of foreign bismuth. During the first 9 months of 1941, imports more than doubled, and exports declined compared with the same period of 1940. The Peruvian Trade Agreement, effective July 29, 1942, halved the import duty on bismuth. Nominal quotations on bismuth remained steady at $1.25 a pound. There was some variance in price of certain bismuth compounds.

[6] Cortell, P., Arsenic in Spain: Ion (Madrid), October 1941; abs. Chem. Trade Jour. (London), vol. 110, February 6, 1942, pp. 145–146.

World production of bismuth totaled an estimated 3,000,000 pounds in 1941, of which the bulk was under control of the Allies.

PRODUCTION

Treatment of some accumulated rich bismuth residues offset an apparent tendency to relax full recovery of bismuth from lead because of the scarcity of magnesium (essential for one lead-debismuthization process) and of the willingness of consumers of lead in their anxiety to secure the metal to tolerate a relatively higher percentage of bismuth, which discouraged maximum refinement. The Anaconda Copper Mining Co., American Smelting & Refining Co., and U. S. Smelting, Refining & Mining Co. continued to be the sole domestic producers. Their production included metal recovered from Mexican lead bullion and from ores imported for smelting and refining from South America, Central America, Australia, and Canada. The Cerro de Pasco Copper Corporation imported large quantities of bismuth and bismuth-lead alloy from Peru to supply the increasing industrial and pharmaceutical demand.

CONSUMPTION

The demand for bismuth doubled in 1941 owing to a great rise in industrial and metallurgical requirements and a slight increase in pharmaceutical applications. It is estimated that 60 percent of the metal was used in pharmaceutical and 40 percent in metallurgical or industrial uses. The industrial demand for bismuth is expected to continue to grow owing to use of the metal as a substitute for tin in solders and to old and new metallurgical uses that the war has greatly expanded. Possibly the industrial or alloy consumption will overtake the pharmaceutical and medicinal use in 1942. Heretofore, as much as 85 to 90 percent of all the bismuth consumed was for medicinal and cosmetic preparations, including various indigestion remedies and toilet powders. Bismuth compounds also are used in treating wounds and venereal diseases, and in 1941 the Army, Navy, and Red Cross reported a substantial growth in demand for bismuth pharmaceuticals.

The Department of Agriculture began experiments in 1941 to replace lead compounds with bismuth subsalicylate in a fungicide spray, which may develop into a sizable use for the metal. The spray is expected to be effective in the treatment of tobacco, potato, and other plant mildew diseases.

The unique characteristics of metallic bismuth—its expansion in passing from the liquid to the solid state, its low melting point, and its nonshrinking properties when alloyed with certain other metals—are responsible for the greatly extended use of the metal in industry and metallurgy. The Cerro de Pasco Copper Corporation, largest supplier of bismuth alloys, has as its principal commercial alloys "Cerrobend" (50 percent Bi.),[7] "Cerrobase" (55.5 percent Bi.), "Cerromatrix" (48 percent Bi.), "Cerrosafe" (42.5 percent Bi.), and "Cerrodent" (38 percent Bi.). In addition, there are several other combinations of bismuth, lead, tin, cadmium, antimony, or mercury containing 33 to 56 percent bismuth. The Federated Metals Division of the American Smelting & Refining Co. began to produce a series of

[7] Curtis, T. M., and Groehn, Harvey G., Cerrobend Tools for National Defense: Modern Industrial Press, November 1941.
Curtis, T. M., Cerrobend Trim Racks and Spotting Fixtures: Tool Engineer, December 1940.
How to Bend Tubes and Sections: Iron Age, vol. 146, No. 19, Nov. 7, 1940, pp. 52–53.

new ST solders containing 3 to 5 percent bismuth early in 1942, a use that is expected to become very important. Bismuth reduces the tin required. Furthermore, the new solders have properties comparable with the conventional lead-tin and lead-silver solders. A new wiping solder containing 0.5 percent bismuth and 25 percent tin also was placed on the market, and more bismuth was used in babbitt alloys. Additions of tin and bismuth to lead-silver alloys also constitute a very acceptable substitute for high-tin solders in many instances.[8] The addition of 0.1 to 0.5 percent bismuth in free-machining stainless steels results in a remarkable and useful increase in machinability with no detriment to, and in some cases an improvement in, the corrosion resistance.[9] Bismuth is expected to replace selenium here as the addition agent. Bismuth also is reported to increase the machinability of brasses.[10]

Of the principal metallurgical uses for bismuth during 1941, it is estimated that 24 percent went into the bending of thin-walled aluminum-alloy aircraft oil and gas tubing and steel sections and for trim racks and spotting fixtures in the aircraft and automobile industry; 24 percent into solder and bearing metal; 18 percent into the manufacture of free-cutting aluminum alloys and miscellaneous pattern work; 13 percent into fusible metal for automatic sprinklers, safety valves, and other protective devices; and 21 percent into various other uses such as anchoring bearing bushings on machine tools, sealing of tanks, mounting airplane propellers during machining, setting or anchoring dies, punches, and other parts, and electroforming and electroplating.

PRICES

Throughout 1941 New York quotations on bismuth metal remained unchanged at \$1.25 a pound, tonlots, according to the Engineering and Mining Journal Metal and Mineral Markets. According to the Oil, Paint and Drug Reporter in May 1941 the price of bismuth subcarbonate (fiber drums) decreased from \$1.73 to \$1.50 a pound and bismuth subgallate from \$1.68 to \$1.40 a pound, whereas prices for bismuth subnitrate and subsalycilate remained steady during the year at \$1.48 and \$2.50 a pound, respectively.

FOREIGN TRADE

Imports of bismuth metal during the first 9 months of 1941 (all from Peru) increased 143 percent compared with those received during the same period in 1940 (81,479 pounds). Receipts of compounds, mixtures, and salts of bismuth were insignificant. Imports not valued chiefly for lead during the first 9 months of 1941 totaled 747,757 pounds, of which 400,528 pounds comprised metals other than lead. This classification included shipments from Peru and the United Kingdom. Of the 708,873 pounds from Peru, only 315,785 were lead; probably the remainder was chiefly bismuth. A new trade agreement with Peru, effective July 29, 1942, reduces the import duty on bismuth metal from 7½ to 3¾ percent ad valorem. According to a

[8] Turkus, S., and Smith, A. A., Jr., Low-Tin Solders Containing Silver and Bismuth: Metals and Alloys, vol. 15, No. 3, March 1942, pp. 412–413.

[9] Pray, H., Peoples, R. S., and Fink, F. W., Addition of Bismuth for Producing Free-Machining Stainless Steels: Proc. Am. Soc. Test. Materials, vol. 41, 1941, pp. 646–655.

[10] Price, W. B., and Bailey, R. W., Bismuth—Its Effect on the Hot-Working and Cold-Working Properties of Alpha and Alpha-Beta Brasses: Am. Inst. Min. and Met. Eng., Tech. Pub. 1441, Metals Technol., June 1942, pp. 1–6.

ruling of the Bureau of the Customs, United States Treasury, mixtures of two or more elements, such as lead, bismuth, etc., and bismuth-lead eutectic alloy are dutiable as a combination of chemical elements not specifically provided for at the rate of 25 percent ad valorem.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1937–41

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1937	67,225	$54,007	3,145	$9,117
1938	92,298	74,583	2,004	3,387
1939	182,832	154,339	297	649
1940	123,880	118,260	4	31
1941 (Jan.–Sept.)	198,162	198,259	15	53

WORLD PRODUCTION AND CONSUMPTION

It is estimated that world production of bismuth in 1941 totaled approximately 3,000,000 pounds, of which the United States, Peru, Mexico, and Canada supplied the greater part. Other producing countries were Bolivia, Spain, Japan, China, Yugoslavia, Sweden, Argentina, Belgium, U. S. S. R., Australia, France, the Union of South Africa, and Germany.

North America.—Mexico produced 215,989 pounds of bismuth in 1941 (408,810 in 1940) and placed an export embargo on bismuth to all countries except the United States and Latin American nations having a satisfactory system of export control. Canadian production of bismuth is not available but is supplied largely by the Consolidated Mining & Smelting Co., Trail, British Columbia, and the Deloro Smelting & Refining Co. Ltd , Deloro, Ontario.

South America.—Production of bismuth in Peru (by the Cerro de Pasco Copper Corporation) in 1941 is reported [11] to have comprised 723,367 pounds of refined bismuth in bars and 422,977 pounds in bars bit refined (bismuth-lead bullion). Output in 1942 is expected to increase substantially over that in 1941. Exports in 1941 totaled 747,369 pounds of metal containing 729,730 pounds of bismuth and 809,096 pounds of bismuth-lead bullion containing 421,083 pounds of bismuth. Bolivia exported 49,833 pounds of bismuth in concentrates in 1941, of which the Compagnie Aramayo de Mines en Bolivio accounted for 15,825 pounds, Fabulosa Consolidated Co. 15,985 pounds, and numerous small operators selling to Banco Minero de Bolivio 18,023 pounds. Production of bismuth in Bolivia could be greatly increased at its tin, tungsten, gold, and bismuth mines but only at considerable cost. Bolivia exported 138,891 pounds of concentrates and ores in 1941 containing 50,706 pounds of bismuth (41,230 in 1940). A plant was established in San Luis, Argentina, in 1941 to recover bismuth metal from the Los Condores scheelite ore. Bismuth was recovered as a byproduct in the São Jose de Brejauva region of Ferros, Minas Gerais, Brazil, in the mining of beryl and aquamarine. From 0.3 to 3.0 percent bismuth occurs in the copper ores of the Pedra Branca region, Paraibo and Rio Grande do Norte, and also in Mariana, Itabirito, and Bomfim, Minas Gerais, and in Iguape, São Paulo.

[11] Foreign Commerce Weekly, vol. 7, No. 1, April 11, 1942, p 20.

Europe.—Unlimited customs licenses were issued in the United States to the British Purchasing Commission in 1941 authorizing the exportation to certain British areas of bismuth metal and alloys; bismuth matte, slimes, and residues; and bismuth salts and compounds. In the United Kingdom bismuth metal was quoted at 6s. 3d. per pound and for 35 percent ore about £110 to £125 per long ton, c.i.f.

Africa, Asia, and Australia.—China produced an estimated 40,000 pounds of bismuth in 1940.

MAGNESIUM

By HERBERT A. FRANKE AND M. E. TROUGHT

SUMMARY OUTLINE

SUMMARY

Events in 1941 forecast that an unprecedented quantity of magnesium would be required for military purposes—for the production of aircraft and incendiary bombs. The War Production Board recommended that magnesium production in the United States be extended more than 90 times that of 1939—to approximately 610,000,000 pounds. In 1941 the production of primary magnesium totaled 32,589,052 pounds—160 percent more than in 1940 (12,521,726 pounds) and 386 percent more than in 1939 (6,700,122 pounds). The 1941 output was greater than the combined output of the previous 4 years. The Dow Chemical Co., an outstanding factor in the magnesium industry since its inception in this country in 1915, was joined by a second producer (for the first time since 1927)—the Permanente Metals Corporation. Dow continued to be by far the principal producer, employing its usual process involving the electrolysis of fused 85-percent magnesium chloride derived from Michigan underground brine and, for the first time, from Texas seawater. Permanente recovered its metal by the new, carbo-electrothermic process, using magnesia from California sea water and Nevada magnesite as its raw materials.

Salient statistics of the magnesium industry in the United States, 1939–41

	1939	1940	1941
Production of primary magnesium.....pounds..	6,700,122	12,521,726	32,589,052
Quoted price per pound [1].....cents..	27.0	27.0	22.5
Imports.....pounds..	76		
Exports.....do....	[2] 4,200,000	1,718,444	[3] 3,098,424
World production (estimated).....short tons..	34,100	49,500	85,500

[1] Lowest nominal price (New York) for primary metal ingot 99.8 percent pure, carlots.
[2] Estimated.
[3] Magnesium metal in primary form, in addition, metal was exported in other forms (86,070 pounds) and in powder (33,383 pounds) during last 6 months of 1941.

Domestic consumption of primary and secondary magnesium in 1941 totaled 29,346,600 pounds compared with 11,531,000 pounds in 1940. Demand for the metal was much greater than the supply, and to meet military requirements mandatory priorities were invoked on magnesium March 3, 1941. Of the primary magnesium shipped or used in 1941, approximately 57 percent went into the production of magnesium-base alloys, virtually all for structural products; 19 percent into other alloys, chiefly aluminum; 6 percent into magnesium products, chiefly nonstructural; 14 percent for export account; and 4 percent into other uses. No magnesium was imported, but more than 3,000,000 pounds were exported. Despite an extraordinary demand for the metal, the market price on 99.8-percent magnesium ingot, carlots, was reduced May 1, 1941, from 27 cents to 22.5 cents a pound.

World magnesium output reached a new peak in 1941, and Germany remained the outstanding producer. Whereas the Axis controlled about 60 percent of the world production during 1941, it is anticipated that in 1942 and 1943 the United Nations will greatly outstrip the Axis in magnesium output.

PRODUCTION

Primary magnesium.—Domestic production of primary magnesium in 1941 totaled 32,589,052 pounds, an advance of 160 percent over the 12,521,726-pound output of 1940. Primary magnesium shipped or used (sales) totaled 31,056,947 pounds. Although the Dow Chemical Co. produced most of the output, the Permanente Metals Corporation contributed a part. Dow placed two entirely new 18,000,000-pound units in operation on the Texas seacoast and expanded annual capacity at its Michigan plant to 18,000,000 pounds. Permanente, the first of 10 new producing companies, started operations in the fall of 1941 with a unit rated at 8,000,000 pounds annual capacity.

Output of the United States is expected to exceed 125,000,000 pounds in 1942 and may reach the goal of 610,000,000 pounds in 1943. The first expansion program announced June 13, 1941, by the Office of Production Management, stated that tremendously increased aircraft and military requirements made it necessary to extend annual productive capacity to approximately 400,000,000 pounds. Soon thereafter, the Dow Chemical Co., Permanente Metals Corporation, Basic Magnesium, Inc., Diamond Magnesium Co., Mathieson Alkali Works, Inc., and International Minerals & Chemicals Corporation (Union Potash) began laying plans for constructing these additional production facilities. By February 1942, however, military needs had risen to a point where a second magnesium-expansion program had to be scheduled, increasing annual capacity to approximately 725,000,000 pounds.[1] This goal was later reduced to 610,000,000 pounds. The following table shows the total projected magnesium program, which, when completed, will make the Government owner of 86 percent of all the domestic magnesium-producing capacity.

[1] Wilson, Philip D., Enlarging Magnesium Output a Hundredfold. Min. and Met., vol. 23, No. 424, April 1942, pp. 201-204.

Projected magnesium-producing capacity of the United States in 1943, in millions of pounds

Operating company and plant location	Magnesium raw material	Process	Rated magnesium capacity	
			Company owned	Government owned
Dow Chemical Co.:				
Midland, Mich	Underground brine.	Dow electrolytic	[1] 18	
Freeport, Tex	Sea water	do	[1] 18	18
Dow Magnesium Corporation:				
Marysville, Mich	Underground brine (and dolomite).	do		72
Velasco, Tex	Sea water	do		72
Permanente Metals Corporation:				
Permanente, Calif. (and Moss Landing, Calif.).	do	Carbo-electrothermic.	[2] 48	
Manteca, Calif	Dolomite	Ferrosilicon		20
Mathieson Alkali Works, Inc.: Lake Charles, La.	Dolomite (and alkali liquors).	Dow electrolytic		54
Diamond Magnesium Co., Painesville, Ohio.	do	do		36
International Minerals & Chemicals Corporation, Austin, Tex (and Carlsbad, N. Mex.).	Langbeinite and dolomite.	do		24
Basic Magnesium, Inc.: Las Vegas, Nev. (and Gabbs, Nev.).	Magnesite	Magnesium Elektron electrolytic.		112
New England Lime Co.: Canaan, Conn.	Dolomite	Ferrosilicon		10
Ford Motor Co.: Dearborn, Mich	do	do		40
Electro Metallurgical Co. Spokane, Wash.	do	do		48
Amco Magnesium Co.: Wingdale, N. Y.	do	do		10
National Lead Co.: Luckey, Ohio	do	do		10
Total capacity			84	526

[1] Small part British-financed.
[2] Partly Reconstruction Finance Corporation-financed, and capacity expected to be reduced.

The Dow Chemical Co. has developed its process involving electrolysis of fused 85-percent magnesium chloride ($MgCl_2.H_2O$) since 1916. At Midland, Mich., bromine and the sodium and calcium salts in underground brine are first removed by evaporation, filtration, and fractional crystallization; chlorine is added during the process, and the purified magnesium chloride solution remaining is concentrated further by crystallization to yield $MgCl_2.6H_2O$ (hexahydrate). The hexahydrate is partly dried and fed to specially designed, rectangular, cast-steel cells, where the fused magnesium chloride, with some added sodium chloride, is electrolyzed. The metal deposited at the cathode collects on the surface of the electrolyte, from which it is removed at intervals. In addition to high-purity metal, the cell produces byproduct dilute hydrochloric acid and chlorine. Early in 1941 Dow developed an underground brine field near Ludington, Mich., where wells have penetrated magnesium chloride brines richer than those near Midland at a 2,800-foot depth. This brine, containing about 10 percent $MgCl_2$, will be concentrated and shipped to Marysville, Mich., where it will be enriched with dolomite, converted to hexahydrate, and treated electrolytically. Some of the Ludington brine was shipped by railroad tank cars to Midland during the first part of 1942. At Freeport and Velasco, Tex., Dow adds milk of lime to sea water and precipitates magnesium hydroxide, which is thickened, filtered, and treated with hydrochloric acid to produce

$MgCl_2.6H_2O$.[2] This is made almost anhydrous and electrolyzed in the same manner as at Midland. In the interest of the war effort, the Dow Chemical Co. offered (through the Office of Production Management and the Defense Plant Corporation) its process and technique to the Diamond Alkali Corporation and the International Minerals & Chemicals Corporation. The Dow Magnesium Corporation was formed to operate the Velasco and Marysville plants for the Defense Plant Corporation.

The Mathieson Alkali Works, Inc., developed jointly with the staff of the Consolidated Mining & Smelting Co. (Trail, B. C.) a special type of electrolytic cell which is reported to be advantageous at present in that almost 3 pounds of concentrated chlorine gas are produced for each pound of magnesium metal made and a slight saving in electric current is indicated. Mathieson will treat waste calcium chloride solution from its Solvay process with calcined dolomite and carbon dioxide to produce magnesium chloride solution and byproduct calcium carbonate. The calcium carbonate precipitate is filtered off and the magnesium chloride solution purified, evaporated, and dehydrated enough for electrolysis. The operation makes possible the economic disposal of huge quantities of calcium chloride resulting from the ammonia-soda process for sodium carbonate production and the use of low-cost dolomite.

The Diamond Magnesium Co. not only takes advantage of the fact that dolomite, a double carbonate of lime and magnesia, can supply the lime needed for its Solvay ammonia-soda process but, in conjunction with some of the process waste liquors, the magnesia yields a cheap magnesium chloride. Some of Diamond's cell feed will be derived from waste liquors, and some will be produced by direct treatment of calcined dolomite with hydrochloric acid. Hydrated dolomite will be treated with the chloride waste liquors to produce magnesium hydroxide and calcium chloride, which will be carbonated with kiln gases. The calcium carbonate is precipitated and the magnesium chloride obtained is made almost anhydrous. The regular Dow type of cell will be employed in the electrolysis.

Magnesium will be produced by the International Minerals & Chemicals Corporation (at Austin, Tex.) primarily from magnesium chloride derived as a byproduct in the base exchange of langbeinite ($K_2SO_4.2MgSO_4$) and sylvite (KCl) solutions (which average about 17 percent $MgCl_2$) in the production of sulfate of potash by its subsidiary, the Union Potash & Chemical Co., at Carlsbad, N. Mex. Part of the cell feed, however, will be derived from hydrated dolomite, carbonated with kiln gases, and treated with hydrochloric acid produced as a byproduct from the Dow-type electrolytic cell. Heretofore the company wasted substantial quantities of the magnesium chloride solution at Carlsbad.

Basic Magnesium, Inc., will employ another magnesium chloride electrolytic process, which differs from that of Dow's primarily in that it employs a completely anhydrous feed instead of an almost anhydrous magnesium chloride. The so-called M. E. L. method was developed in Germany by I. G. Farbenindustrie, A. G., and later

[2] Murphy, Walter J., Magnesium from the Sea: Chem. Ind., vol. 49. No. 6, November 1941, pp. 618-628.
Kirkpatrick, Sidney D., Magnesium from the Sea: Chem. and Met. Eng., vol. 48, No. 11, November 1941, pp. 76-84
Killeffer, D. H., Magnesium from the Sea. Am Chem. Soc. (News Ed.), vol. 19, No. 21, November 10, 1941, pp. 1189-1193.

was used by Magnesium Elektron, Ltd., at Clifton Junction, England, after which the Nevada plant is modeled. A tremendous quantity of magnesite must be quarried and concentrated by flotation for this huge plant. Plans are to quarry the magnesite[3] and transport the beneficiated raw material from Gabbs, Nye County, northeast of Luning, Nev., to Las Vegas, over 300 miles away. Raw magnesite and magnesium oxide sinter (from Herreshoff roasters) will be ground and briquetted with coke and British Columbia peat moss to make a spongy, porous mass, which will be roasted and treated with chlorine gas to produce anhydrous magnesium chloride. The chlorine gas will be derived partly from gases evolved from the magnesium cells and partly from the electrolysis of sodium chloride.

The Permanente Metals Corporation will employ two different processes to produce magnesium—the direct carbo-electrothermic and the ferrosilicon reduction methods. Development of the carbothermal process has been largely credited to Fritz J. Hansgirg, an Austrian scientist, who designed and installed the initial unit at Permanente, Calif.[4] The method involves many difficult problems, primarily because it is based upon a chemical reaction easily reversible and requires the maintenance of a reducing or inert environment throughout to prevent reoxidation. Operations of the plant have been retarded by explosions and fires resulting from the difficulties of controlling temperatures and vacuums, which is so highly essential. Briefly, the Hansgirg process consists in mixing coke and calcined magnesia and heating the mixture in an electric arc furnace at about 2,100° C. and then suddenly "shock-cooling" the resultant vaporized metal at about 200° C. with natural gas. The finely divided magnesium or powder, separated from the gas by Cottrell precipitators, is contaminated with carbon, magnesium oxide, and other impurities and must be redistilled. It is mixed with oil and the doughy mixture redistilled in special furnaces, the oil and then the magnesium being vaporized. High-purity magnesium crystals are recovered from the top of the furnace. In 1941 Permanente employed magnesium oxide obtained from sea water and Nevada magnesite by the Westvaco Chlorine Products Co. at Newark, Calif., as its raw material. Early in 1942 the company abandoned its original plan to rely upon Nevada magnesite and began constructing its own sea-water magnesia plant at Moss Landing, Calif. By the summer of 1942, two carbothermal units had been completed, but neither unit had yet approached its rated capacity.

The ferrosilicon process was largely adopted for the second magnesium expansion program. Work thereon was pioneered by Dr. L. M. Pidgeon of the Canadian National Research Council,[5] the Ford Motor Co., and the Electro Metallurgical Co. Its adoption was recommended by the National Academy of Sciences The process involves briquetting high-grade dead-burned dolomite and pulverized ferrosilicon (75-percent grade) and heating in a horizontal or vertical furnace or some other form of retort equipped with a condenser unit.

[3] Hewett, D. F., Callaghan, E., Moore, B. N., Nolan, T. B., Rubey, W. W., and Schaller, W. T., Mineral Resources of the Region Around Boulder Dam: Geol. Survey Bull. 871, 1936, pp. 142–143.

[4] Kirkpatrick, Sidney D., Magnesium by the Hansgirg Process: Chem. and Met. Eng., vol. 48, No. 9, September 1941, pp. 91–94.

[5] Breyer, Frank A., Pidgeon Ferrosilicon Process for Magnesium: Chem. and Met. Eng., vol. 49, No. 4, April 1942, p. 87.

Killeffer, D. H., Magnesium from Dolomite by Ferrosilicon Reduction: Chem. and Eng. News, vol. 20, No. 6, March 25, 1942, p. 369.

Reduction takes place under high vacuum at about 1,150° C., and the vaporized magnesium is condensed as a metal of high purity in the water-cooled section of the retort. Any fuel (such as gas, oil, or electricity) that will give uniform heat at constant temperature can be used. It is reported that a pressure of less than one-tenth millimeter should be maintained in the furnace. The charge is heated with the particular equipment selected long enough to vaporize most of the magnesium in the dolomite. Residue remaining in the retort after heating consists chiefly of dicalcium silicate, calcium oxide, and some magnesium oxide and ferrosilicon. Approximately 1 pound of ferrosilicon and 12 pounds of dolomite are required to produce 1 pound of magnesium metal. Attention was drawn to the process because it requires a minimum of electric power (chiefly that used in production of ferrosilicon), it utilizes dolomite (which is very abundant), and a plant can be erected in a relatively short time. The process, however, necessitates substantial expansion of ferrosilicon production capacity and the use of a large quantity of critical nichrome steel for manufacture of the retorts.

The Ford Motor Co., Electro Metallurgical Co., Permanente Metals Corporation, New England Lime Co., Amco Magnesium Co. (American Metals Co.), and National Lead Co. will construct magnesium plants using the ferrosilicon process; some of them will start operation by the summer or early fall of 1942. Ferrosilicon will be supplied by other concerns, except for the Electro Metallurgical Co., which is constructing its own 48,000,000-pound ferrosilicon plant near Spokane.

Dolomite [6] for the various magnesium plants probably will be obtained by Ford and Dow from Ohio and Michigan, by Mathieson from Burnet County, Tex., by Permanente from deposits near Salinas, Monterey County, Calif., and by the other companies from deposits relatively near their plants.

Other companies, raw materials,[7] and processes [8] were considered in connection with the production of magnesium, but the program to date has not permitted their inclusion. Olivine, dunite, and serpentine have been considered as raw materials for the production of magnesium, and processes receiving attention have included ferrosilicon, thermal, and hydrochloric acid processes.[9] The Defense Plant Corporation allocated funds for drilling and testing carnallite-sylvite beds in the vicinity of Thompsons, Grand County, Utah (in connection with Utah Magnesium Corporation) and of magnesium chloride brines near Gail, Borden County, Tex. (by Ozark Chemical Co.). The Geological Survey and Bureau of Mines cooperated in these drilling programs, as well as in the investigation of magnesite, dolomite, brucite, brines, and other magnesium-bearing raw materials, particularly in the western United States.

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[6] Colby, Shirley F., Occurrences and Uses of Dolomite in the United States: Bureau of Mines Inf. Circ. 7192, November 1941, 21 pp.

[7] Franke, Herbert A., Our Magnesium Resources: Min. Cong. Jour., vol. 27, No. 8, August 1941, pp. 16–22. The Future Sources of Magnesium: Pres. at Ind. Min. Div. Meeting, Am. Inst. Min. and Met. Eng., Rolla, Mo., October 23, 1941, 9 pp.

Seaton, Max Y., Production and Properties of the Commercial Magnesias: Pres. at Ind. Min. Div. Meeting, Am. Inst. Min. and Met. Eng., Rolla, Mo., October 23, 1941, 42 pp.

[8] Pannel, Ernest V., Magnesium Progress in America: Metal Ind. (London), vol. 59, Nos. 21, 22, and 23, November 21 and 28 and December 5, 1941, pp. 322–323, 338–339, and 359–360.

[9] Houston, E. C., and Rankin, H. S., Olivine as a Source of Magnesium: Pres. at Ind. Min. Div. Meeting, Am. Inst. Min. and Met. Eng., Rolla, Mo., October 23, 1941, 7 pp. (See Chem. and Met. Eng., vol. 49, No. 4, April 1942, pp. 149–150).

The Aluminum Co. of America, American Magnesium Corporation, Magnesium Development Corporation, Dow Chemical Co., General Aniline & Film Corporation, and I. G. Farbenindustrie, A. G., were indicted by the Department of Justice on January 30, 1941, for violation of the Sherman Antitrust Law. Charges stated that these companies had retarded and stifled production by pooling patents, maintaining high prices, limiting consumers to one domestic source of supply, and making unlawful agreements pertaining to foreign sales and output in the United States. On April 15, 1942, the first five companies filed a plea of nolo contendere (no consent), and a consent decree was entered that provides for compulsory and free licensing of patents held by the defendants for producing and fabricating magnesium during the war. The concerns and individuals contended that this action was taken to settle the case at any cost as quickly as possible so that time (more important for the production and fabrication of aluminum and magnesium) could be devoted entirely to defeat of the Axis and that actually none was conscious of wrongdoing. Fines imposed aggregated $110,000 for the corporation defendants and $30,000 for the individuals. The half interest owned by the General Aniline & Film Corporation in the American Magnesium Corporation was purchased by the Aluminum Co. of America on February 6, 1941, when a huge magnesium-fabrication expansion program also was inaugurated.

Production and fabrication of magnesium were threatened by short-lived strikes of the Die Casting Workers (C. I. O.) at the Cleveland plant of the American Magnesium Corporation in April 1941 and by the Gas, Coke, and Chemical Division of the United Mine Workers (C. I. O.) at the Midland plant of the Dow Chemical Co. in June 1941.

Explosions and fires damaged magnesium plants of the Permanente Metals Corporation (ingot), National Magnesium Corporation (powder), and Wellman Bronze & Aluminum Co. (castings) during 1941.

Old and new companies that expanded or began to fabricate magnesium products during 1941 and the first half of 1942 through the Defense Plant Corporation were: American Radiator & Standard Sanitary Corporation, at Louisville, Ky., and Elyria, Ohio—sand castings for aircraft engines and wheels; Bendix Aviation Corporation, at Bendix, N. J.—castings (1,920,000 pounds annually); Dow Magnesium Corporation, at Bay City, Mich.—sand castings (700,000 to 900,000 pounds monthly); Ferro Enameling Corporation, at Bedford, Ohio—powder (200,000 pounds monthly); Hills-McCanna Co., at Chicago, Ill.—sand castings (30,000 pounds monthly); Howard Foundry Co., Inc., at Chicago, Ill.—sand castings; Revere Copper & Brass, Inc., at Rome, N. Y.—forgings; and Wellman Bronze & Aluminum Co., at Cleveland, Ohio—castings.

Secondary magnesium.—Recovery of secondary magnesium totaled 1,752 short tons in 1941 and required the consumption of 2,279 tons of magnesium scrap, which was almost entirely new scrap. Of the quantity of magnesium recovered, 929 tons were as ingot and 738 went into castings, 60 into aluminum alloys, and 25 into chemical reagents. During the first part of 1942, six companies had been authorized to remelt scrap and produce secondary magnesium: Aluminum & Magnesium, Inc., American Magnesium Corporation, Apex Smelting Co., Dow Chemical Co., Federated Metals Division of

American Smelting & Refining Co., and National Smelting Co. Additional information on secondary magnesium will be found in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

After magnesium was placed under mandatory priority control, virtually all of the metal was consumed for military purposes, for the production of airplanes and incendiary bombs. Apparent primary consumption exceeded that in 1940 by 151 percent. Of the primary magnesium shipped or used in 1941 (31,056,947 pounds), approximately 57 percent was used in the production of magnesium-base alloys, virtually all for structural products; 19 percent in other alloys, chiefly aluminum; 6 percent in magnesium products, chiefly nonstructural; 14 percent for export account; and 4 percent in other uses.

As magnesium oxidizes readily at temperatures above the melting point, approximately 27 percent of the metal consumed in the production of magnesium-base alloys and the manufacture of structural products was lost or burned in processing.

Production, sales, imports, exports, and apparent consumption of primary magnesium in the United States, 1939–41, in pounds

Year	Production	Sales	Imports	Exports	Apparent consumption[1]
1939	6,700,122	10,650,121	[2] 76	[3] 4,200,000	6,450,200
1940	12,521,726	12,823,633	....	[4] 1,668,765	11,154,868
1941	32,589,052	31,056,947	....	3,098,424	27,958,523

[1] Does not consider fluctuations in consumers' stocks and metal derived from scrap. Withdrawals from producers' stocks totaled 3,949,999 pounds in 1939 and 301,907 pounds in 1940, additions to producers' stocks totaled 1,447,615 in 1941.
[2] Includes alloys and scrap (magnesium content).
[3] Estimated.
[4] Of the 1,718,444 pounds of metal exported, 49,679 pounds consisted of magnesium alloy.

Actual consumption of magnesium (from primary and secondary sources) totaled 29,346,600 pounds. Of this, 75 percent was used in the manufacture of magnesium-base alloy structural products, 23 percent in aluminum alloys, and 2 percent in other uses.

Actual domestic consumption of primary and secondary magnesium (magnesium content), 1940–41, by uses, in pounds

Use	1940	1941
Structural products[1]	7,363,200	21,951,900
Aluminum alloys	3,556,500	6,762,200
Other alloys	85,600	59,000
Scavenger and deoxidizer	361,600	130,400
Pyrotechnics	43,500	383,200
Chemicals	70,200	27,600
Other	50,400	32,300
Total	11,531,000	29,346,600

[1] Castings, sheet, extruded shapes, forgings, etc.

Magnesium-alloy structural products manufactured and sold or used in the United States increased 150 percent over those of 1940. The manufacture of nonstructural products advanced 84 percent. Of the structural products sold or used, sand and permanent mold cast-

ings comprised 87 percent, die castings 6 percent, extruded products 3 percent, sheet 3 percent, and other structural products 1 percent. Of the nonstructural products, powder comprised 68 percent, stick 28 percent, and shavings, turnings, wire, ribbon, and other products 4 percent. The value of sand and permanent mold castings manufactured in 1941 averaged \$2.07 a pound, die castings \$1.50 a pound, and all castings \$2.03 a pound (compared with \$1.71 in 1940).

Magnesium products (other than ingot) manufactured in the United States and sold or used by the companies manufacturing the products, 1939–41

Product	1939		1940		1941	
	Pounds	Value	Pounds	Value	Pounds	Value
Structural products:						
Castings:						
Sand and permanent mold	1,321,080	\$2,030,175	3,973,757	\$7,345,050	11,944,618	\$24,669,146
Die	525,372	385,770	699,212	653,289	768,162	1,155,048
Sheet	180,896	116,287	322,664	246,476	431,306	309,749
Structural shapes, rods, tubing (extrusions)	308,443	185,746	410,912	349,123	451,394	313,638
Forgings	17,065	26,925	25,938	34,602	25,734	79,605
Other structural	3,404	2,553	43,047	134,251	54,119	84,718
Total structural products	2,356,260	2,747,456	5,475,530	8,762,791	13,675,333	26,611,904
Nonstructural products:						
Stick	(1)	(1)	435,483	128,500	407,470	121,105
Powder	232,244	228,129	349,429	410,859	982,078	1,305,418
Shavings, wire, ribbon, and sawdust					52,111	37,163
Total nonstructural products	232,244	228,129	[2] 784,912	[2] 539,359	1,441,659	1,463,686
Grand total	2,588,504	2,975,585	[2] 6,260,442	[2] 9,302,150	15,116,992	28,075,590

[1] Not available. [2] Revised figures.

Of the magnesium-alloy structural products sold or used, the aircraft industry took 96 percent and incendiary bomb casings and other industries, 4 percent. Of that going into the aircraft industry, 61 percent was for the manufacture of engines (including propellers), 22 percent for wheels, 10 percent for frames, and 7 percent for aircraft accessories. Sand, die, and permanent mold castings comprised 95 percent of all the magnesium-alloy structural products sold or used in the aviation field.

Consumption of magnesium-base alloy structural products in 1941, by uses

Use	Pounds	Use	Pounds
Aircraft:		Portable machine equipment and tools	146,427
Engine	7,943,998	Textiles	90,811
Frame	1,358,988	Foundry equipment	55,097
Wheel	2,878,833	Oil-field equipment	2,395
Accessories	885,666	Printing	8,293
Incendiary bomb casings	15,116	Other industries	62,143
Automotive	181,972		
Stationary machines	45,594	Total	13,675,333

Fabricators of magnesium structural products increased from 30 in 1940 to 38 in 1941 and of nonstructural products from 4 to 6. By the end of 1941, 24 companies were producing sand castings, 2 per-

manent mold castings, 10 die castings, 2 extruded products, 2 forgings, and 5 powder. The largest producers of alloy structural products were the American Magnesium Corporation, Dow Chemical Co., Wright Aeronautical Corporation, Bohn Aluminum & Brass Corporation, Eclipse Aviation Co. (subsidiary of Bendix Aviation Corporation), Springfield Bronze & Aluminum Co., Doehler Die Casting Co., Harvill Aircraft Corporation, Hills-McCanna Co., Magnesium Products Corporation, and Ford Motor Co. Producers of powder included American Magnesium Corporation, Magna Manufacturing Co., Magnesium Corporation of America, National Magnesium Co., and National Metals Co.

Stocks of primary magnesium materials on hand at producers' and consumers' plants December 31, 1941, totaled 6,092,699 pounds, including 3,312,179 pounds of primary and 2,780,520 pounds of alloy ingot. Stocks of secondary materials totaled 293,995 pounds.

NATIONAL DEFENSE AND WAR MEASURES

As the demand for magnesium became greater than the supply, production of the metal was placed under mandatory priority status by the Office of Production Management on March 3, 1941. Preceding this action, on February 12, 1941, the Director of Priorities had directed that all manufacturers and fabricators of magnesium give preferential consideration to defense projects. General Preference Order M-2 was issued March 24, 1941. All defense orders for magnesium were thereby assigned a preference rating of A-10 or better. A statement of March 26 stipulated that defense orders for Great Britain were to receive the same priority treatment as those of the United States. On November 14, 1941, General Preference Order M-2-b was issued, conserving the supply and directing the distribution of magnesium, which prohibited its contamination and debasement; allocated the output of producers, approved smelters and fabricators; confined all purchase orders to uses bearing a rating of A-1-j or higher; made inventory and scheduling provisions, and provided for the collection, segregation, and disposition of scrap.

As the need for aircraft and incendiary bombs multiplied, the magnesium-production program was increased by the Office of Production Management, first on June 13, 1941, from a previously contemplated 75,000,000 pounds to 400,000,000 pounds annually. Six domestic companies became identified with this first magnesium-expansion program—Dow, Permanente, Basic Magnesium, Diamond, Mathieson, and International Minerals (Union Potash). As war and lend-lease requirements rose, the War Production Board announced the second expansion program (on February 26, 1942) extending capacity to approximately 610,000,000 pounds. Five additional companies were added to the six previously named concerns—Ford, Electro Metallurgical, New England Lime, American Metals, and National Lead.

PRICES

Dow's price for 99.8-percent standard four-notch ingots (17 pounds) of magnesium, carlots (30,000 pounds minimum), was reduced from 27 cents to 22.5 cents a pound on May 1, 1941. For less than carlots, 100 pounds or more, the price was dropped from 29 cents to 24½

cents. Quotations for 4-inch-diameter by 16-inch ingots (12 pounds) and six-notch ingots (6 pounds), carlots, were reduced to 23.5 cents and for extruded sticks to 32 cents. The new price quoted on magnesium alloys (except Dowmetal "M" and "R-1"), in carlots, standard four-notch ingots (21 pounds), was 24.5 cents a pound, and on the standard 3-pound die-casting ingot, 25.5 cents. All quotations were f. o. b. producing plant, with freight allowed on 100 pounds or more to all points in the United States. On January 1, 1942, the above quotations on magnesium alloys were increased ½ cent a pound. Magnesium-ingot quotations in London remained stationary at 1s. 6d. a pound during 1941.

FOREIGN TRADE

No magnesium was imported in 1941. Exports of magnesium metal in primary form in 1941 totaled 3,098,424 pounds valued at $860,486, of which 2,313,227 pounds went to the United Kingdom, 656,420 to Canada, 64,771 to Australia, 40,000 to Argentina, 20,000 to Mexico, 2,340 to China, and 1,666 to various other countries. In 1940 exports totaled 1,718,444 pounds valued at $582,961. Official records on exports of the metal in other forms (available only for the last 6 months of 1941) totaled 86,070 pounds valued at $29,620, of which 58,398 pounds were consigned to the United Kingdom and 25,116 to Canada. Exports of magnesium powder from July 1 to December 31, 1941, totaled 33,383 pounds valued at $14,797, of which 26,575 pounds were sent to the United Kingdom and 6,500 to Canada. The metal has been under export control since November 5, 1940.

TECHNOLOGIC DEVELOPMENTS

Mass production of magnesium resulted in new methods for recovering the metal from various raw materials and the development of improved fabricating technique. Most of the new magnesium processes have already been discussed in this chapter under "Production." The Bureau of Mines investigated three new magnesium processes believed to have merit—the direct electrothermic method involving carbon reduction of magnesium oxide and condensation by an oil spray, use of molten lead to condense electrothermic magnesium vapor and subsequent electrolysis of the lead, and direct reduction of magnesium oxide in an electrolytic cell. Operation of a pilot plant at Pullman, Wash., revealed that a light stove oil is as effective as gas for shock-cooling magnesium vapor when atomized in a nozzle of proper design.[10] Further work is planned on the two-stage continuous distillation of the oil sludge formed in the electrothermic process.

Radically new fabrication methods were placed in operation by the manufacturers of magnesium powder, of which there were over 10 in June 1942. Mounting aircraft requirements prompted the construction of large, new, streamlined magnesium-alloy sand-casting foundries. Among the up-to-date melting, casting, and heat-treating installations are those of Ford, Wright Aeronautical, American Magnesium, Dow, Bohn, Magnesium Products, Hills-McCanna,

[10] Doerner, H. A., Holbrook, W. Floyd, Dilling, E. Don, Harris, Dwight L., Magnesium by Electrothermic Reduction. Bureau of Mines Rept. of Investigations 3635, 1942, 47 pp.

Aluminum Industries, Light Metals, Superior Bearing Bronze, Eclipse Aviation, Wellman Bronze & Aluminum, and Springfield Bronze & Aluminum.[11] Advancements also were made in the manufacture of permanent and semipermanent mold castings and of die castings, sheet, strip, plate, extruded shapes, and forgings. Companies that formerly fabricated other metals started manufacturing magnesium-alloy products in 1941 and early 1942. Dow and American Magnesium remained the only producers of sheet.

Preliminary static tests were completed on a magnesium-alloy airplane wing to determine its possible weight saving and general suitability for aircraft construction.[12] Progress was made in 1941 on methods for combatting corrosion of magnesium.[13] Numerous patents were issued on improved methods for producing, treating, and protecting magnesium and its alloys. Studies were made on the extinguishment and control of magnesium and incendiary-bomb fires.[14] Care of atmospheres and heat-treating methods for magnesium products became increasingly important.[15] Demand increased during 1941 for high-purity magnesium alloys in which the iron, nickel, and copper impurities were removed—Dow metal J-1, for extrusions, sheet, and forgings; O-1, for extrusions and forgings; and FS-1, for sheet and extrusions. These new alloys have high corrosion resistance.

WORLD PRODUCTION

World production and consumption of magnesium in 1941 set a record. Most of the metal found its way into the manufacture of airplanes and incendiary bombs. Of the world output, it is estimated that about 60 percent was under Axis control and 40 percent under control of the Allied Nations.

Estimated world production of magnesium, 1937–41, by countries, in metric tons

Country	1937	1938	1939	1940	1941
Australia					200
France	1,500	1,800	2,500	2,000	3,000
Germany	12,080	14,100	16,500	25,000	35,000
Italy	66	102	300	500	2,500
Japan	1,200	1,500	2,000	3,000	5,000
Norway					100
Switzerland	230	750	750	750	1,000
U. S. S. R.	500	500	1,000	1,500	4,000
United Kingdom	2,000	2,200	4,831	6,500	12,000
United States	[1] 2,059	2,918	3,039	5,680	14,780
Total	19,600	23,900	30,900	44,900	77,600

[1] Sales.

[11] Phair, W. A., Magnesium Aircraft Castings: Iron Age, vol. 148, No. 8, August 21, 1941, pp. 39-44.
Briskin, N. M., Magnesium Sand Castings: Iron Age, vol. 148, No. 2, July 10, 1941, pp. 47-53.
Cone, Edwin F., The Ford Magnesium-Alloy Foundry: Metals and Alloys, vol. 15, No. 3, March 1942, pp. 396-402.

[12] Conlon, Emerson W., and Mathes, John C., Preliminary Static Test of a Magnesium-Alloy Wing: Pres. at Ann. Meeting, Inst. Aeronautical Sci., January 28-30, 1942. (Preprint, 8 pp. and illus.)

[13] Hanawelt, J. D., Nelson, C. E., Peloubet, J. A., Corrosion Studies of Magnesium and Its Alloys: Am. Inst. Min. and Met. Eng. Tech. Pub. 1353, April 1941, 26 pp.
Schmidt, H. W., Finishing Magnesium Die Casting: Am. Soc. Test. Mat., vol. 41, 1941, pp. 15-22.

[14] Guise, Arthur B., Protecting Industrial Plants from Magnesium Fires: Chem. and Met. Eng., vol. 48, No. 6, June 1941, pp. 85-87.
Bureau of Mines, Methods of Extinguishing Magnesium Fires and Incendiary Bombs with Very Hard Coal-Tar Pitch: December 15, 1941, 3 pp.

[15] Nelson, C. E., Atmosphere Control in the Heat Treatment of Magnesium Products: Pres. at Am. Soc. Metals, October 20-21, 1941.

Australia.—Production at a 1,000-ton magnesium plant was begun in the summer of 1941 by the Broken Hill Proprietary Co., Ltd., at New Castle, New South Wales. Finely ground calcium carbide and calcined magnesite are heated under vacuum, and the metal obtained is remelted and refined with suitable fluxes.[16]

Canada.—Dominion Magnesium, Ltd., early in 1942 began constructing a 3,500-ton magnesium plant at Haley near Renfrew, Ontario, based upon the dolomite-ferrosilicon process developed by Dr. L. M. Pidgeon of the Canadian National Research Council. The project is sponsored by Bobjo Mines, Ltd., Moneti Associates, and Ventures, Ltd., but cost of the plant ($3,000,000) is to be borne by the Canadian Government. The Consolidated Mining & Smelting Co. of Canada, Ltd., is reported planning construction of a 5,000-ton magnesium plant in eastern Canada. It was first planned to locate this plant in western Canada, near the newly developed Marysville magnesite ore belt (4½ miles long) north of Cranbrook, B. C. At Trail, B. C., this company produced magnesium powder by a new atomization method. At Farm Point near Wakefield, Quebec, the Aluminum Co. of Canada, Ltd., started production of pure granular magnesia suitable for both refractories and the manufacture of magnesium metal from brucitic limestone. Virtually all of the current output, however, is to be used for refractory brick.[17] The British Columbia Magnesium Co., Ltd. (one of several concerns planning the production of magnesium in Canada) began exploratory work in 1941 on magnesite deposits in the Williams Lake and Clinton districts, B. C., of which some ore contains 40 percent MgO and 27 percent Cr_2O_3.

France.—Several leading chemical companies (Pechiney, Ugine, and Bozel-Maletra) plan to increase French production of magnesium. Dolomite and Mediterranean sea-water brine apparently constitute the principal raw materials used. A new plant at Lannemazon in the Pyrenees is expected to be completed early in 1942. Magnesium plants formerly reported in operation are located at Saint-Auban, Jarrie-Vizille, Villard de Bozel, and Moissac.

Germany.—German production of magnesium may have reached 50,000 tons in 1941, as production capacity is believed to have totaled that amount in 1940. Plants operated by the I. G. Farbenindustrie, A. G., were located at Bitterfeld (employing a process similar to Dow's with potash end liquor and magnesite), at Aken near Dessau (Magnesium Elektron process), and at Wintershalle; and by the Wintershall A. G. (the potash combine) at Wintershalle and Heringen (employing an electrolytic process with carnallite). Two new plants in central Germany and the rebuilt Radenthein (Austria) plant probably were in operation also. German interests were expected to complete construction of a 10,000-ton magnesium plant in Norway in 1941 based upon sea water and potentially available hydroelectric power.

Italy.—Italian magnesium production has been estimated in 1941 at 800 to 3,000 tons. The Fraschini automobile and Montecatini chemical interests are producingm agnesium from dolomite in northern

[16] Chemical Engineering and Mining Review, Magnesium Manufacture in Australia Vol. 34, No. 400, January 10, 1942, pp. 121-126.

[17] Goudge, M. F., Sources of Magnesia and Magnesium in Canada Canadian Min and Met. Bull. 360, April 1942, pp. 191-207.

ern Italy, and Montecatini is recovering magnesium from sea water on the Ligurian coast.

Japan.—Magnesium production is believed to have been greatly increased in 1941, and 15 companies (which the Government was attempting to consolidate) are said to have been established early in the year. Probably the five best-established and largest producers were the Nichiman (Japan-Manchuria) Magnesium Co., Ltd. (at Ube, Yamaguchi Prefecture—2,000 tons capacity); Japan Magnesium Metal Co., Ltd. (at Konan, South Kanyo Province, Chosen—2,000 tons); Asahi Electro-Chemical Industry Co., Ltd. (at Tokyo—560 tons); Japan Soda Co., Ltd. (at Toyama—360 tons); and Manchurian Magnesium Manufacturing Co. (at Yinkow, Manchuria—3,000 tons). Adequate supplies of raw material are available to Japan from the immense magnesite reserves at Tashihchiao and on the Liao-Tung Peninsula in Manchuria and in Chosen, and from the sea-water bitterns of the Gulf of Liao Tung and the Inland Sea.

United Kingdom.—Magnesium Elektron, Ltd., and Magnesium Metals & Alloys, Ltd., are estimated to have produced about 12,000 tons of metal in 1941 and are expected to double that amount in 1942. Domestic dolomite, sea water, Greek magnesite, and magnesite from West and South Africa are used as raw materials.

ANTIMONY

By T. H. Miller and A. L. Ransome [1]

SUMMARY OUTLINE

SUMMARY

Under the impetus of rising demand, the antimony industry made general over-all gains during 1941. Although imports from China advanced over those in 1940, a continued shortage of Chinese metal stimulated domestic consumers of antimony to look to increased Mexican and South American ore supplies, which were augmented by a larger domestic production. World production is estimated to have been 55 percent greater than the 1938 total of 32,000 metric tons, based upon comparative gains from countries that produced 57 percent of the 1938 total.

High prices resulted from the increased competition, and 50- to 55-percent ores quoted at \$1.25 to \$1.35 a short-ton unit, New York, at the beginning of 1941 were priced at \$2.00 to \$2.10 at the close of the year. Despite the sharp rise in ore prices, the quotation for domestic metal remained at 14.00 cents a pound, New York, the same as in 1940. Quotations for Chinese metal were nominal at 16.50 cents, duty paid, throughout the year, a continuation of the 1940 price.

Domestic production of antimony ore and concentrate advanced 208 percent over 1940, but metal content rose only 146 percent, an indicated average drop in grade from 44 percent in 1940 to 35 percent in 1941. The antimony content of antimonial lead produced from all classes of domestic and foreign ores increased 42 percent over the 1940 figure and was the largest recorded since 1929. The content of the total production of antimonial lead at primary refineries from all raw materials—scrap and domestic and foreign ores—increased 19 percent and was the largest since 1929. Primary antimony available for consumption increased 67 percent to the highest point reached in many years. Stocks of metallic antimony at producers' plants, as reported to the Bureau of Mines, decreased from 1,048 short tons at the end of 1940 to 730 tons on December 31, 1941. The Laredo (Tex.) smelter and Kellogg (Idaho) electrolytic plant both reported marked increases in

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce

production that greatly exceeded a drop in output from the Los Angeles smelter. The new electrolytic plant of the Sunshine Mining Co., under construction, should contribute to increased total production in 1942.

Figure 1 shows trends in world production from 1910 to 1938 and United States imports and prices from 1910 to 1941.

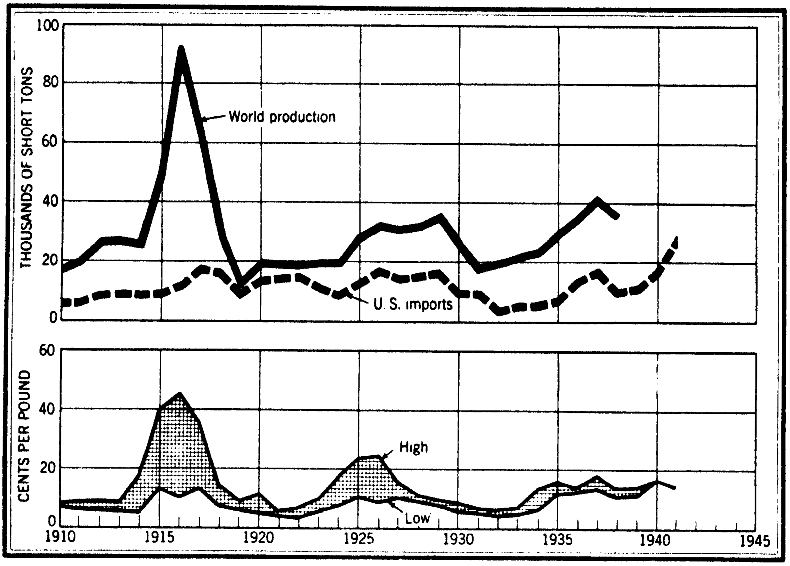

FIGURE 1.—Trends in world production, 1910–38, and United States imports and New York price of antimony, 1910–41.

Salient statistics for antimony in the United States, 1937–41

	1937	1938	1939	1940	1941
Production of antimony ore and concentrates ... short tons..	4,250	2,730	3,174	1,124	3,460
Antimony contained ... do...	1,266	650	393	494	1,214
Antimony content of antimonial lead produced from domestic and foreign ores ... short tons..	1,726	2,080	1,108	2,077	2,958
Secondary antimony produced ... do...	12,340	8,500	9,810	11,421	21,629
Imports for consumption:					
Antimony in ore ... do...	13,818	8,322	9,448	15,733	19,386
Needle or liquated antimony ... do...	772	90	228	113	638
Metal ... do...	1,043	821	1,045	209	7,469
Oxide ... do...	1,118	414	167	...	...
Exports of foreign antimony ... do...	437	711	58	276	70
Primary antimony available for consumption ... do...	18,132	11,557	11,609	17,955	29,994
Stocks of antimony in bonded warehouse at end of year short tons..	656	345	685	3,417	416
Average price of antimony at New York: [1]					
Chinese ... cents per pound..	15.30	14.59	14.44	[2] 16.50	[2] 16.50
American ... do...	15.35	12.35	12.36	14.00	14.00
World production ... short tons..	42,100	35,600	(3)	(3)	(3)

[1] According to American Metal Market.
[2] Nominal.
[3] Figures not yet available.

NATIONAL DEFENSE

The strategic aspects of antimony are based upon the dependence of the United States on imported ores and metal to supply the demand for which domestic production can fill only a minor, but increasing, percentage. The dislocation of the Chinese antimony industry since

1937 has led to substantial changes in world antimony industry, which have tended to reduce the dependence of this country, among other democracies, on Chinese supplies. The decline in Chinese exports has been more than offset by the expansion in production, with American financial aid, in Mexico and Bolivia, of which virtually the whole supply is available to the United States. Notwithstanding this potential supply, antimony was comparatively scarce throughout 1941, but no mandatory priorities were invoked during the year by the Office of Production Management, even though some metal was withdrawn from Government stock piles to relieve shortages. On September 13, 1941, the Metals Reserve Co. announced that 7,014 tons of Chinese and 1,250 tons of domestic metal had been delivered to its stock pile, and 19,623 tons of foreign and 1,750 tons of domestic antimony were on order.

On August 21, 1941, American antimony prices advanced 0.50 cent a pound to 14.50 cents, New York—the first price change recorded since September 23, 1939. This rise was short-lived, however, as the Office of Price Administration and Civilian Supply on August 22 requested that the 14.00-cent level be maintained; it remained at that point until March 23, 1942, when the Office of Price Administration allowed the price advance to 15.96 cents for small case lots.

On March 30, 1942, allocation control over antimony was ordered by the Director of Industry Operation of the War Production Board, with issuance of General Preference Order M-112, effective May 1. Under this order, deliveries of antimony were strictly controlled. Subsequently, on July 11, 1942, order M-112 was amended to allow up to 50 tons a month of contained antimony in ore or concentrates to be delivered by producers without restriction.

DOMESTIC PRODUCTION

MINE OUTPUT

The extent of the increased activity as regards antimony in 1941 is not apparent from the record of production of antimony ores and concentrates alone. The number of producing mines and prospects has nearly doubled, as is indicated by the fact that 37 properties contributed to the country's total production of antimony ores in 1941 compared with 19 in 1939. In addition, much development work in the past year or two has not yet resulted in production. Moreoever, mines containing ores that are produced principally for their values in metals other than antimony have supplied increasing quantities of this metal for domestic consumption. The augmented supplies of antimony from ores containing values mainly in silver, copper, and other metals were available partly as the result of operation of the new Bunker Hill & Sullivan Mining & Concentrating Co. plant at Kellogg, Idaho.

There were 3,460 tons of material, containing 1,214 tons of antimony, classed as antimony ores and concentrates produced in 1941 compared with 1,124 tons of material containing 494 tons of antimony in 1940. Upon the basis of antimony content, the record for 1941 was surpassed in only 3 previous years—1915, 1916, and 1937. Shipments totaled 2,834 tons containing 1,018 tons of antimony in 1941 compared with 1,108 tons containing 490 tons in 1940.

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The development of new large reserves of low-grade antimony ore by the Bureau of Mines at the Yellow Pine mine, discussed briefly under Idaho, and the availability of markets in Los Angeles and Laredo, among others, for small as well as large lots of domestic ores, foretell a substantial increase in output of antimony from domestic mines, should a prolonged war require. The new Bunker Hill plant at Kellogg and the prospective Sunshine Mining Co. plant at Big Creek near Kellogg indicate that larger quantities of antimony will be available from domestic silver, copper, and other ores not classed as antimony ores.

Alaska.—Shipment of antimony ores from Alaska in 1941 was again confined to the Stampede mine of Morris P. Kirk & Son, Inc., in the Kantishna district. The total for 1941 considerably exceeded tonnages for 1938 to 1940 but was below the record for 1937. Much of the ore shipped from this deposit in 1941 was mined during 1939–40 and held in storage awaiting a more favorable market. Early shipments consisted of hand-sorted ore, but beginning in 1939 shipments comprised both ore and concentrates from a small mill installed in that year. In the early months of 1942 it was reported that the property had been acquired from Kirk by Earl Pilgrim, manager for Kirk since operations at the property were begun in 1936. It was also reported at that time that new milling equipment was to be installed.

Antimony deposits of the Stampede Creek area have been described in a report by Donald E. White of the Geological Survey, available for consultation in the Washington office of the Survey. White says that a large fault, the Stampede fault, has probably controlled the deposition of the antimony ore. The Stampede mine contains several veins or series of veins, one of which branches from the Stampede fault at a small angle. The veins are commonly wider and higher in grade near the premineral cross faults, which are tight and slightly mineralized. Several ore bodies have been found in the veins immediately east and north of cross faults—that is, on their hanging-wall sides. However, the largest ore body, called the Surface ore body, lay between the Stampede fault and the offshooting vein. The antimony is present principally as stibnite. White estimated that the reserves, including ore partly developed, amount to about 70 tons of shipping-grade ore containing at least 50 percent antimony and 6,000 tons of low-grade ore, capable of concentration, which has a minimum content of 10 percent antimony. In addition, the surface material below the outcrop of the principal ore body is estimated to contain at least 1,000 tons of oxidized ore with a tenor of 20 percent. Mill tailings amounting to 5,000 tons contain 6 percent antimony and may eventually be reworked. The estimates of reserves do not include possible ore in bodies not yet discovered or completely undeveloped ore in known bodies.

Mining at the Stampede mine was recently described.[2]

Arizona.—Less than 1 ton of antimony ore was produced and shipped from the Walker district in 1941. The mine in the Tip Top district, from which a small shipment was made in 1940, was inoperative during 1941.

California.—The Hilltop and Bishop properties in Inyo County produced antimony ores in 1941, and small quantities came from two properties in Kern and one in San Bernardino County. The location

[2] Gallaher, Robt. A., Sub-Arctic Antimony Mining. Mining World, vol. 3, No. 7, July, 1941, pp. 21–23.

of one producer was unreported. Some ore was also shipped in less than ton lots.

Production and shipments for the State amounted to only 51 tons of ore containing about 15 tons of antimony, marking a decline from the 74 tons containing 29 tons of antimony in 1940. Shipments in 1941 moved almost entirely to the El Segundo plant of Harshaw Chemical Co., near Los Angeles. This company took over the plant operated by Menardi Metals Co. in 1940.

Antimony deposits in the Stayton district, which lies 13 miles northeast of Hollister and includes parts of San Benito, Santa Clara, and Merced Counties, were described in a report that is one of a series on strategic minerals investigations.[3] According to the report, the antimony reserves of the district cannot be closely estimated because high-grade pockets are distributed sporadically. The breccia veins, exclusive of rich pockets, average less than 1 percent antimony, and, although the total amount of antimony they contain is a few tens of thousands of tons, the average grade is much too low for mining to be profitable, even at the high average price of 22 cents a pound that prevailed during the First World War years 1915–18. Small, high-grade pockets were not expected to raise the average tenor of any considerable length of breccia vein to more than 1½ percent.

Idaho.—As has usually been the case in the recent past, Idaho was the principal producer in 1941 of antimony ores and concentrates. Output amounted to 1,823 tons containing 655 tons of antimony, and shipments totaled 1,249 tons containing 483 tons of antimony. In addition to such ores, an even larger amount of antimony came from ores classed as silver ores, copper ores, and others, not included in this report as mine output of antimony. The Yellow Pine mine, operated by the Bradley Mining Co., is the largest source of antimony in the United States. This mine is owned by the United Mercury Mines, which also owns and operates the second-largest producing antimony mine in Idaho in 1941—the Antimony Ridge. Operations at the Yellow Pine mine were described by Bradley,[4] who stated that 492,977 tons of ore assaying $5.93 a ton in gold was milled from 1932, when the Yellow Pine Co. began operations (it was succeeded in 1938 by the Bradley Mining Co.), until January 1, 1941. The average net, smelter return for gold, silver and antimony was $4.17 a ton. During this 9-year period, 68,364 ounces of gold, 213,569 ounces of silver, and 7,875,878 pounds of antimony were recovered from the concentrates.

The Bureau of Mines has developed an important reserve of low-grade antimony ore in the Yellow Pine mine, in connection with its strategic metal program. Drilling has revealed 2,315,000 tons of ore containing 43,900 tons of antimony. This ore must be considered mostly subcommercial at normal prices, although it is believed that about 300,000 tons may prove commercial if proper milling equipment is used.

One other mine in Valley County and two properties in Shoshone County produced small quantities of antimony ore or concentrates in 1941.

Idaho antimony ores were shipped to the Texas Mining & Smelting Co., Laredo, Tex.; Harshaw Chemical Co. (also Menardi Metals Co.,

[3] Bailey, Edgar H., and Myers, W. Bradley, Quicksilver and Antimony Deposits of the Stayton District, California. Geol. Survey Bull. 931-Q, 1942, pp. 405–434.

[4] Bradley, John D., Mining and Milling Methods and Costs at the Yellow Pine Mine, Stibnite, Idaho. Bureau of Mines Inf. Cir. 7194, 1942, 11 pp.

which preceded it), El Segundo, Calif.; United States Smelting, Refining & Mining Co., Midvale, Utah; and Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho.

Montana.—Small quantities of antimony ores were produced and shipped in 1941 from near Thompson Falls in the Burns district, Sanders County. Mines and claims reported to have been active were the Stibnite Hill, Eureka, Ellis, Coeur d'Alene, and Interstate. Production and shipments totaled 113 tons containing 43 tons of antimony.

Nevada.—A greater number of antimony properties were active in Nevada than in any other State during 1941. Operations were reported in every section of the State, and the producing counties are given as follows, in descending order of importance: Nye, Lander, Pershing, Humboldt, White Pine, and Washoe. There were 16 shippers of lots of more than 1 ton each. The average size of antimony operations was small, and the average grade of ore produced was low, as is indicated by the fact that totals for the State were 691 tons, containing 146 tons of antimony, produced and 669 tons, containing 138 tons of antimony, shipped. A number of shipments of less-than-ton lots were made. The Harshaw Chemical Co. (which succeeded Menardi Metals), El Segundo, Calif., was the destination of the larger number of shipments, and the Texas Mining & Smelting Co., Laredo, Tex., received the remainder.

Oregon.—The chapter of this series, review of 1940, pointed out that prospecting was done on antimony deposits in Baker and Jackson Counties in that year. This work resulted in production and shipments of ore from both counties in 1941. Shipments of more than ton lots were made from the Gray Eagle (Koehler) and one other property in Baker County and from the Jay Bird in Jackson County.

Washington.—Two properties in Okanogan County were reported to have produced and shipped antimony ore in 1941—the Antimony Queen in the Methow district and the Lucky Knock in another district.

SMELTER OUTPUT

In 1941 primary antimony for shipment to others was produced from foreign and domestic ores at three plants in the United States: Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho; Harshaw Chemical Co., Menardi Metals Division, El Segundo, Calif.; and Texas Mining & Smelting Co., Laredo, Tex. In addition, metallic antimony was produced by the American Smelting & Refining Co. at its Omaha (Nebr.) plant but was converted into other products such as antimonial lead and was not sold as metallic antimony.

The Sunshine Mining Co. began to construct an antimony plant at Big Creek, Idaho (near Kellogg), early in 1942, to be in operation by late summer of that year. The plant will be the fourth in the United States and is designed to recover the antimony content of silver-bearing tetrahedrite ore mined by the company. It is planned to treat custom antimony ore as well. The capacity is reported to be 200,000 pounds of metal a month.

Imports of antimony ore in 1941 amounted to 41,662 short tons containing 19,386 tons of antimony, compared with 37,966 tons in 1940 containing 15,733 tons of metal, an increase of 23 percent in terms of antimony content. The following table, which shows consumption and stocks of foreign antimony in the United States during

1940 and 1941, lists receipts of 40,434 tons of ore in 1941 and 34,530 tons in 1940 or 97 and 91 percent, respectively, of the total amount imported. The difference in each instance is attributable to the usual lag in reporting imports on one hand and receipts on the other, plus the fact that a certain percentage of total stocks is in transit and not statistically accounted for in the receipts. Receipts exceeded consumption in 1940, and stocks of antimony ore increased 33 percent (gross weight). The reverse was true in 1941, and stocks declined 56 percent. Although receipts increased 17 percent over 1940, consumption of 46,211 tons (containing 20,530 tons of antimony) in 1941 was 44 percent above the reported consumption of 31,982 tons (containing 13,421 tons of antimony) in 1940.

Consumption and stocks of foreign antimony ore in the United States during 1940 and 1941, in short tons

	Gross weight of antimony ore	
	1940	1941
Stocks at beginning of year	7,775	10,323
Received during year	34,530	40,434
Consumed during year	31,982	46,211
Stocks at end of year	10,323	4,546

Production of antimonial lead at primary lead refineries is shown in the accompanying table. The figures cover only part of the total antimonial lead production, as large quantities are produced at plants that operate exclusively on scrap, and some hard lead is made by mixing antimony and soft lead.

Antimonial lead produced at primary lead refineries, 1937–41, in short tons

Year	Production	Antimony content				
		From domestic ores	From foreign ores [1]	From scrap	Total	
					Quantity	Percent
1937	27,524	1,636	90	853	2,579	9.4
1938	24,123	1,871	209	729	2,809	11.6
1939	21,995	929	179	923	2,031	9.2
1940	29,762	1,915	162	867	2,944	9.9
1941	40,237	2,586	372	552	3,510	8.7

[1] Includes lead ores, antimony ores, and metallic antimony.

SECONDARY PRODUCTION

A large part of the total antimony available for consumption each year in the United States is recovered in the treatment of secondary nonferrous metals. The production of antimony from secondary metals in 1941 totaled 21,629 tons—an 89-percent increase from the 11,421 tons produced in 1940. Primary antimony available for consumption in the United States in 1941 totaled 29,994 tons. Total antimony available was thus 51,623 tons, including 58 percent primary and 42 percent secondary; the ratios in 1940 were 61 and 39 percent, respectively.

Most of the secondary antimony is recovered from old scrap returning from worn-out and obsolescent equipment. In 1941, old scrap yielded 21,572 tons of antimony and new scrap 57 tons. Lead-base alloys, chiefly antimonial lead, supplied 99 percent of the total secondary antimony recovered in 1941; most of the remainder came from tin-base scrap. Discarded storage batteries are the largest single source of secondary antimony. In 1941 plants treating secondary metals reported the consumption of 264,190 tons of battery lead plates containing 12,681 tons of recoverable antimony or 59 percent of the total secondary antimony produced. Babbitt of all types, including Mixed Common, No. 1, and Genuine, yielded 2,347 tons of antimony, and 4,089 tons came from type metals and drosses. The remainder of secondary antimony in 1941 came from hard lead (yielding 2,268 tons of antimony), cable lead (216 tons), and No. 1 pewter (28 tons).

Most of the plants treating scrap metals containing antimony also consume other antimony materials, such as antimony ore or metallic antimony. These materials are used to adjust or "sweeten" the antimony content of the products. Refined metallic antimony is rarely produced from scrap metals, as most of the output is in the form of lead-base and tin-base alloys. Much of the production is in the form of antimonial lead returned directly to the storage-battery trade. Antimony oxide, sodium antimonate, and other compounds are also produced from scrap metals. Additional information on secondary antimony is given in the chapter on Secondary Metals—Nonferrous.

DOMESTIC CONSUMPTION

Data on the consumption of primary antimony in the United States are not available owing to the lack of complete information on dealer and consumer stocks and on the quantity of domestic antimony recovered in alloys other than antimonial lead and in compounds. Comprehensive surveys of producers and consumers of antimony and antimony materials are currently being conducted by the Bureau of Mines and should give a nearly complete picture for 1942. However, an approximate idea of the trend of consumption can be obtained from the following table, which shows the annual supply available for consumption.

Primary antimony available for consumption in the United States, 1937–41, in short tons [1]

	1937	1938	1939	1940	1941
Domestic antimony recovered in antimonial lead	1,636	1,871	929	1,915	2,586
Imports for consumption (antimony content)					
Antimony ore	13,818	8,322	9,448	15,733	19,386
Needle or liquated [2]	540	63	160	79	447
Compounds [3]	909	336	138	4	2
Type metal, etc	410	355	121	191	202
Regulus	1,043	821	1,045	209	7,460
Total available	18,356	11,768	11,841	18,131	30,092
Exports under draw-back	224	211	232	176	98
Available for consumption [4]	18,132	11,557	11,609	17,955	29,994

[1] Excludes domestic antimony recovered as miscellaneous alloys, oxides, and other compounds.
[2] Content estimated at 70 percent.
[3] Content estimated at 80 percent.
[4] Figures are low owing to somewhat incomplete data concerning some items of domestic production.

Primary antimony available for consumption in 1941 increased 67 percent over the total for 1940. Imports of regulus and ore increased to a marked degree, and domestic production also advanced. According to the American Bureau of Metal Statistics, 131,000 tons of antimonial lead were used in manufacturing storage batteries during the year compared with 115,600 tons in 1940 and 106,500 tons in 1939. This battery metal contains 4 to 12 percent antimony, largely from scrap, although a substantial quantity of new metal is added to raise the alloy to the required ratio.

An important use of antimony is in white-base antifriction bearing metals. According to the Bureau of the Census, shipments of this material produced for sale and for plant consumption in 1941 totaled 33,146 tons compared with 26,701 tons in 1940. The manufacturers reporting data that give the above totals represent almost the entire industry.

The use of antimony in making chemicals continued to grow in 1941, as the production of oxide and other compounds increased 43 percent to 14,588 short tons containing approximately 11,590 tons of metal. Figures on the production of compounds in the 4 preceding years, with the estimated antimony content in parentheses, are as follows: 1940, 10,211 tons (8,223); 1939, 7,668 tons (6,188); 1938, 4,393 tons (3,539); 1937, 6,992 tons (5,667). Nearly all of this material was made from foreign ores. Oxide, the most important compound, is used extensively in paints, lacquer, synthetic enamel, porcelain enamel, and glass. The following companies reported production of oxide and other salts in 1941: American Smelting & Refining Co., 120 Broadway, New York, N. Y.; Harshaw Chemical Co., 1945 East 97th Street, Cleveland, Ohio; McGean Chemical Co., 1106 Republic Building, Cleveland, Ohio; Menardi Metals Co., Division of Harshaw Chemical Co., El Segundo, Calif.; Texas Mining & Smelting Co., Laredo, Tex.; and Rare Metal Products Co., Belleville, N. J.

Still another and expanding use for antimony, although comparatively small, is in the treatment of canvas and other textiles against rotting and fire. The importance of such a use for military purposes at present is obvious.

PRICES

The price of domestic brands of metallic antimony was quoted at 14.00 cents a pound in New York throughout 1941, the same as in 1940. A one-half cent advance posted in August 1941 was quickly withdrawn at the request of the Office of Price Administration, and no further advance was made until March 23, 1942, when the quotation was listed at 15.96 cents by permission of Office of Price Administration. An additional allowed rise on April 13 brought the price to 16.01 cents, where it remained at the end of July 1942. The quotation of 16.50 cents a pound for Chinese metal, which had been in effect during all of 1940, remained the same throughout 1941 and was unchanged at the end of July 1942; the price was nominal.

On the London market the price of English regulus (minimum, 99 percent antimony) was £85 from December 31, 1940, until May 23, 1941, when it increased to £95. The quotation continued to advance during the following 5 months to £120 on October 10, where the price remained for the rest of 1941; it was still quoted at this level at the end of June 1942. Foreign regulus (spot deliveries from warehouse,

duty paid) was quoted at £90 at the end of 1940. Subsequent prices throughout 1941 and the first half of 1942 were the same as those of the English regulus.

Average monthly quoted prices of antimony, prompt delivery at New York, 1937–41, in cents per pound

Month	Chinese brands (duty paid)[1]					American brands[2]				
	1937	1938	1939	1940[3]	1941[3]	1937	1938	1939	1940	1941
January	14.14	15.56	14.00	16.50	16.50	14.14	13.75	11.68	14.00	14.00
February	14.69	15.74	14.00	16.50	16.50	14.55	13.75	11.25	14.00	14.00
March	16.92	15.75	14.00	16.50	16.50	16.37	13.75	11.27	14.00	14.00
April	16.79	15.65	14.00	16.50	16.50	16.02	13.65	11.50	14.00	14.00
May	14.79	14.46	14.00	16.50	16.50	14.79	12.46	11.70	14.00	14.00
June	14.70	13.94	14.00	16.50	16.50	14.70	11.73	12.00	14.00	14.00
July	14.79	14.00	14.00	16.50	16.50	14.81	11.02	12.00	14.00	14.00
August	15.53	14.00	14.00	16.50	16.50	15.34	10.88	12.00	14.00	14.00
September	(4)	14.00	14.00	16.50	16.50	16.59	11.32	12.87	14.00	14.00
October	(4)	14.00	14.24	16.50	16.50	16.92	12.06	14.00	14.00	14.00
November	15.91	14.00	[3] 16.50	16.50	16.50	15.87	12.25	14.00	14.00	14.00
December	14.69	14.00	[3] 16.50	16.50	16.50	14.12	11.56	14.00	14.00	14.00
Average	15.30	14.59	14.44	16.50	16.50	15.35	12.35	12.36	14.00	14.00

[1] Metal Statistics, 1940, p. 529, except for 1940 and 1941, which were taken from daily issues of American Metal Market.
[2] Metal Statistics, 1942, p. 551.
[3] Nominal.
[4] No average, owing to lack of offerings during greater part of month

Quotations for antimony ore on January 2, 1941, according to Engineering and Mining Journal Metal and Mineral Markets, were as follows: "Per (short-ton) unit of antimony contained, at New York, 50 to 55 percent, \$1.25 @ \$1.35; 58 to 60 percent, \$1.40 @ \$1.50; 60–65 percent, \$1.50 @ \$1.60. London, 60 to 65 percent, 9s.3d. per long-ton unit." Increased competition for the available ore supply resulted in higher prices which, by January 1, 1942, reached \$2.00 @ \$2.15 for the lower-grade ore, \$2.15 @ \$2.25 for intermediate-grade, and \$2.25 @ \$2.35 for higher-grade at New York, and 14s.9d. for higher-grade in London. These prices fluctuated slightly throughout the first month of 1942 but rose in April to \$2.15 @ \$2.20, \$2.20 @ \$2.30, and \$2.30 @ \$2.40 for the lower, intermediate, and higher grades, respectively. The New York quotations were unchanged at the end of July, but the London price for the higher-grade was quoted at 12s.9d. in May.

FOREIGN TRADE

The following tables show imports and exports of antimony and antimony products.

Antimony imported for consumption in the United States, 1937–41

Year	Antimony ore			Needle or liquated antimony		Antimony metal		Antimony oxides and other compounds	
	Short tons	Antimony content: Short tons	Antimony content: Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	42,453	13,818	\$1,775,011	772	\$101,963	1,043	\$228,485	1,136	\$249,152
1938	19,811	8,322	1,095,497	90	12,016	821	155,420	420	94,400
1939	21,000	9,448	1,132,359	228	30,102	1,045	196,812	173	29,786
1940	37,966	15,733	2,027,612	113	19,464	209	50,048	5	1,851
1941	41,662	19,386	2,717,472	638	126,018	7,469	2,056,678	2	537

Antimony imported for consumption in the United States, 1940–41, by countries

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1940					
Argentina [1]	56	31	$5,876		
Belgium				7	$2,276
Bolivia [1]	9,250	5,547	860,813		
China				194	45,126
Colombia	13	7	615		
Honduras	10	5	1,671		
Mexico	27,525	9,545	1,065,296		
Peru	1,112	598	93,341	2	488
United Kingdom				6	2,158
	37,966	15,733	2,027,612	209	50,048
1941					
Belgium				22	4,248
Bolivia	11,695	7,094	1,210,118		
Burma	30	18	3,673		
China	2	1	145	7,115	1,950,990
Costa Rica	28	17	2,250		
Honduras	24	11	1,970		
Mexico	28,706	11,664	1,399,896	328	100,309
Peru	1,177	581	99,420	4	1,131
	41,662	19,386	2,717,472	7,469	2,056,678

[1] Imports credited to Argentina originate largely in Bolivia.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1937–41, in short tons [1]

Year	Type metal and antimonial lead	Other alloys [2]	Total	Year	Type metal and antimonial lead	Other alloys [2]	Total
1937	[3] 17	393	410	1940	191		191
1938	[3] 59	296	355	1941	202		202
1939	59	62	121				

[1] For details of gross weight and values, see imports shown in Lead chapter of this volume.
[2] Chiefly in special antimony-lead alloys containing high percentage of antimony. [3] Type metal only.

Foreign antimony (regulus or metal) exported from the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	437	$86,991	1940	276	$75,440
1938	711	96,836	1941	70	19,690
1939	58	16,736			

As in other recent years, imports of antimony ore in 1941 came principally from Mexico and Bolivia. Imports from Bolivia increased 26 percent in 1941, and receipts from Mexico were the highest on record, except for 1937 when 34,736 short tons were imported. Imports for consumption of 7,469 tons of antimony metal in 1941, nearly all from China, were the highest recorded since 1930.

In addition to the exports of foreign metal reported in the last table above, 98 tons were exported in finished products under the draw-back provisions of the tariff law; draw-back exports amounted to 176 tons in 1940 and 232 tons in 1939. Stocks of antimony in bonded warehouses on December 31, 1941, totaled 416 tons compared

with 3,417 tons at the end of 1940. The drop is due largely to the release of Chinese metal stocks held by the Metals Reserve Co.

WORLD PRODUCTION

Statistics on world production, which were incomplete for 1939 and 1940, are even less complete for 1941 because of the war and its effect on the release of information from the nations involved. Data from countries that supplied 84 percent of the total recorded world output in 1938 indicated a 14-percent increase over that year in total world production during 1940. Similarly, statistics from countries that produced 57 percent of the world total in 1938 indicate a 55-percent increase over that year in total world production during 1941. Although Mexican output decreased, the loss was more than offset by gains in Bolivia. All other countries from which data were available showed increases over 1940.

REVIEW BY COUNTRIES

Argentina.—During 1940 the total production of antimony ore in Argentina was approximately 250 tons, including antimony oxides, sulfides, and ores associated with silver, iron, copper, and arsenic. A corresponding figure for 1941 is not available. The source of antimony is chiefly small mountain mines in the Provinces of Jujuy and La Rioja. The Pabellon mine, Jujuy, is the principal producer. A small tonnage of antimony is obtained annually as a byproduct of imported Bolivian lead ores.

Bolivia.—The main antimony-producing regions in Bolivia are near Tupiza, Llallagua, and Oruro. The stibnite ore bodies are generally spotty, and the ore is mined and concentrated by rudimentary hand methods, which yield low recovery with a tailings content ranging from 5 to 10 percent. More than 80 percent of the total exports of antimony is supplied by the Banco Minero de Bolivia from purchased production of small miners. Recent demand for antimony has resulted in a steady increase in output, which reached 24,923 metric tons of ore containing 14,870 tons of antimony in 1941.

Brazil.—Several occurrences of antimony have been reported in Brazil, and the deposits of Morro do Bule, near Ouro Preto, State of Minas Gerais, and also Cananea, State of São Paulo, are considered of value for commercial exploitation.

Canada.—The high prices for antimony prevailing in the latter part of 1941 renewed the interest in the Stuart antimony deposit at Ferguson Creek, Bridge River district, British Columbia. This property was discovered in 1925 but has not been developed. Late in 1941 a considerable quantity of ore from the Bridge River area was sacked and shipped to the United States for treatment.

China.—Production from China during 1940 was 5,493 metric tons, including antimony content of regulus, crude antimony, and oxide exported. No figures for 1941 are available. New antimony deposits are being explored, with the expectation of increasing output 1,000 to 2,500 tons annually.

Approximately 99 percent of the antimony mines lie in southwestern China, in territory still under Chinese control. Exports from all of China during 1940 were 326 metric tons of crude antimony and 5,248 tons of regulus.

Late in 1941 Japanese military interests were reported to be organizing an antimony refinery at Wuchang, Hupeh, in central China, capitalized at yuan 3 million, but no other details are available.

Cuba.—Antimony is found in the MacKinley area in the northwestern part of the Isle of Pines, and small amounts were shipped to the United States in 1941.

Honduras.—A trial shipment of antimony ore (25 long tons) from a property near La Union, Department of Olancho, was sent to the United States in the third quarter of 1941. The Yoro Mining Co. and the Honduras Mining Co. have been idle during 1941, principally because transportation costs between the deposits and the ports of shipment have been too high for profitable operation.

India.—Several sources of antimony ore have been found recently in India as the result of exploration, and a refining plant to treat these ores may be installed in the near future.

Japan.—It is reported that increased output of antimony is planned by the semigovernmental antimony mining company in Japan. This step has been taken as a result of the ban imposed by Bolivia on exports of antimony to Japan. Current antimony production covers less than a quarter of Japan's consumption, which has risen sharply in recent years.

Mexico.—The most recent available information on the antimony industry in Mexico appears in the November 20, 1941, issue of Mineral Trade Notes, published by the Bureau of Mines, from which the following notes have been abstracted.

Deposits of antimony are found in 14 States in Mexico. Output from many of the discoveries has been small, but potentialities of several undeveloped deposits are promising. Lack of even medium-sized formal mining operations in the Mexican antimony industry is noteworthy. In only a few instances, notably at San Juan Mixtepec, Oaxaca, and at Wadley, San Luis Potosi, are properties large enough to justify installation of mechanical equipment. The greater portion of antimony comes from small, scattered operations, mostly close to the surface with very little depth attained by the workings. Likewise most of these operations are carried on under the "buscon" and "gambusino" systems, in which the individual miner is almost entirely the sole judge of where, when, and how the work is to be performed.

Up to a short time ago almost the entire production of antimony in Mexico was controlled by Cia. Minera y Refinadora and by Cia. Minera de Oaxaca. However, within the past few months, several other organizations and individuals have entered actively into the field, largely from the ore-purchasing angle.

The Republican Mining Co. was the earliest formal organization in Mexico for the production of antimony. This company was the forerunner of the Texas Mining & Smelting Co., of which Cia. Minera y Refinadora is a subsidiary. Cia. Minera de Oaxaca is owned mainly by the Madera Bros. of Mexico City, but the Texas company also has a substantial stock interest in it. Operations of Cia. Refinadora are confined generally to the area north of Queretaro, while Oaxacá operates to the south.

The principal antimony area is in the western part of Oaxaca near San Juan Mixtepec just west of Tlaxiaco. Cia. Minera de Oaxaca controls the most important developments in the area. During 1940 production in Oaxaca totaled 5,100 tons, averaging 56 percent antimony—2,900 tons of oxide ore and 2,200 tons of sulfide ore. The sulfide ore normally averages 52 to 57 percent Sb, while the oxides occasionally run as high as 80 percent.

The antimony deposits in the vicinity of Wadley, 165 kilometers north of San Luis Potosi, formed the nucleus for the mining operations of the Republican Mining Co. This company, originally organized by the Cookson interests of England, built a smelter at Wadley, which operated until 1930 when the Cookson interests were reorganized, the smelter closed, and a new plant opened at Laredo, Tex. The initial operation of the Republican Mining Co. was the San Jose mine, high in the hills about 7 miles east of Wadley. Originally, work on the property

was performed on company account, but, with the type of ore body found, this system proved unprofitable and upon reorganization of the corporation was abandoned. At present, work is conducted on the "gambusino" system, which in general principles corresponds to leasing operations in the United States. Development work in search of new ore bodies is done by the company, as the gambusinos are unwilling to perform work where there is no certainty of a direct return.

Just north of Wadley is the old mining district of Catorce with a considerable record of past production of precious metals, but now almost dormant except for a small output of antimony. This ore comes from small scattered operations, and the greater part is purchased by Refinadora and shipped to Laredo. Production from the district averages about 60 tons monthly, virtually 95 percent of which is oxide ore containing 25 percent Sb. Individual lots average from 20 to 40 percent. Between Catorce and Wadley, at Nantanzas, 60 to 80 buscones are producing about 80 tons of ore monthly.

The principal antimony-producing regions of the State of Queretaro lie in the central and eastern parts of the State in the vicinity of Toliman, Bernal, El Doctor, and Jalpan. The largest amount of development and greatest production has been in the area nearest Toliman and Bernal. In this section several other large mining operations have produced over a period of several years. At present the most active of these properties is owned and operated by Augustine B. Carrasco. Carrasco operates one of the few concentrating plants for the beneficiation of antimony ore. The plant uses gravity methods and is turning out 60 tons of 50-percent concentrate monthly. The mine also produces between 60 and 70 tons monthly of direct shipping ore.

The State of Zacatecas is one of the oldest mining areas in Mexico with a recorded production dating back to 1540 when the mines were first discovered by the Spaniards. In 1940 the State ranked sixth in output of antimony, when 201 tons were recovered. The chief antimony areas are in the northern part of the State in the vicinity of Sombrerete, Nieves, and Pacheco. Refinadora, which maintains agencies in the larger towns and even in small villages, has been the chief outlet for the ore. The deposits worked so far are small, irregular pockets close to the surface and with little indication of continuity. Operations have been carried on for several years, but no appreciable depth has been attained, rarely more than 15 to 20 meters.

During 1940 Durango produced only 161 tons of antimony, all reported by Refinadora as obtained from the Cuencame and San Bartolo districts. Scattered antimony deposits are reported in the State, but most of them are in the eastern and northeastern sections. The ore is comparatively low in grade, ranging from 25 to 30 percent.

Three widely separate districts in Sonora are known to contain deposits of antimony ore and to have shipped appreciable amounts in past years. These are near the village of Antimonio, about 100 miles west of Santa Ana on the Southern Pacific, 66 miles south of Nogales; Sahuaripa, in the central part of the State near the Chihuahua line; and in the vicinity of Nacozari, south of Douglas, Ariz. The Antimonio district, or as more generally called the Caborca district, has been an important source of antimony. Shipments have been made during the past 25 years and at the present average 100 tons of metal contained in ore monthly. The ore as shipped averages 45 percent Sb. The workings as yet have not reached any appreciable depth. It is reported that 25,000 tons of 10-percent ore have accumulated on dumps for possible future operations. The deposits in the neighborhood of Sahuaripa are virtually inaccessible. Small amounts of antimony are shipped occasionally, but up to the present the district has been of little importance. Occasional small shipments also are made from Nacozari. Small undeveloped deposits along the Yaqui River near Ramona have been reported.

Several antimony deposits are reported in the State of Guerrero, but to date only the Huitzuco Co. is operating. In June 1941 the company treated 110 to 130 tons of ore daily, averaging 0.23 percent Hg and 1.1 percent Sb. The ore is treated in a modern flotation plant, and the concentrates are shipped to Menardi Metals Co., Los Angeles, Calif., for refining. Production in 1940 totaled 335,155 pounds of antimony, of which 224,058 were recovered from refining operations.

Peru.—In 1941 exports of antimony ore from Peru totaled 2,850 metric tons containing 1,452 tons of metal, 48 tons of antimonial lead ores containing 11 tons of metal, and 2 tons of antimony bar containing 1.8 tons of metal. Antimony is largely mined by small pro-

ducers. It is reported that potentially large deposits occur in the Departments of Arequipa and Puno, but exploitation is restricted by lack of transportation facilities and capital.

The principal development in the antimony industry in Peru is the erection, by the Cerro de Pasco Corporation, of a dust treatment plant, of 100 tons a day capacity, which should be completed in 1942, pending arrival of equipment from the United States. The plant will treat Cottrell dust; 4,000 tons containing 45 percent antimony are stored at the smelter.

Union of South Africa.—According to the Metal Bulletin (London), the Consolidated Murchison (Transvaal) Goldfields and Development Co., Ltd., is now producing antimony flotation concentrates on a fairly substantial scale; these are, for the most part, being shipped to the United Kingdom for treatment. Several small mines are being worked along the Murchison range for the production of antimony alone.

CADMIUM

By Allan F. Matthews

SUMMARY OUTLINE

GENERAL STATEMENT

Cadmium recovery is at a high level in apparently all zinc-lead-smelting countries. More than half of the world output is supplied by the United States, a sixth by the British Commonwealth of Nations and the U. S. S. R., and about a fifth by the Axis-dominated countries. The favorable position of the United Nations is due in part to their control of the flow of cadmium flue dust from Mexico and South-West Africa. Cadmium production in the United States from domestic and imported raw materials reached about 7½ million pounds in 1941, and stocks were drawn upon to meet a consumption of nearly 8 million pounds. Germany was able to supplement its own cadmium output—the second-largest in the world—with quantities from Poland, Norway, and France. Canadian cadmium production, which ranks third, was increased about 30 percent in 1941.

Government supervision.—The job of maintaining production of cadmium in the United States and directing available supplies into war channels was undertaken by the Cadmium Section, Office of Production Management; in April 1941 Harry J. Wolf was appointed chief of the section. During the latter half of 1941 producers marketed their cadmium in normal fashion, although the Office of Production Management watched deliveries and stepped in to handle individually the "hot-spot" situations that developed. Cadmium was placed under full priority control by Office of Production Management Order M–65 on January 17, 1942. The companion Order M–65–a, issued at the same time, prohibited the use of cadmium in automotive, trailer, and tractor equipment, building supplies and hardware, house furnishings and equipment, and a number of miscellaneous products. Order M–65 was modified by an amendment, effective June 24, 1942, that enabled the War Production Board to allocate all cadmium for absolutely essential purposes. The Government stock pile of metallic cadmium, held by Metals Reserve Co., a subsidiary of the Reconstruction Finance Corporation, amounted to 134,400 pounds valued at $139,000 as of October 22, 1941, and was valued at $194,000 as of March 7, 1942. Control of cadmium imports was provided for in Office of Production Management Order M–63 on December 28, 1941, but was revoked by amendment 3, effective March 14, 1942,

because such imports were controlled by other means. During the last three quarters of 1941 primary producers cooperated with the Government in keeping the price of cadmium sticks at 90 cents a pound—the level at which it was formally fixed by Office of Price Administration Price Schedule 71, effective January 19, 1942.

DOMESTIC PRODUCTION

Cadmium established a new record in 1941, when primary production increased 14 percent over 1940. Production of secondary cadmium (derived principally from bearing scrap) now constitutes about 5 percent of the total primary and secondary output. Producers' shipments of primary cadmium were 10 percent larger in 1941 than in 1940. The geographic distribution of primary cadmium production, based upon location of plants that produced metal or compounds (and not upon origin of cadmium-containing ores), in 1941 was as follows: 74 percent from four plants in four Western States (Colorado, Idaho, Montana, and Utah), 18 percent from nine plants in six Central States (Illinois, Kansas, Missouri, Ohio, Oklahoma, and Texas), and 8 percent from six plants in three Eastern States (Connecticut, New York, and Pennsylvania). In the United States cadmium is chiefly a byproduct of zinc production.

Cadmium produced, shipped by producers, imported, and exported in the United States, 1937–41, in pounds

	1937	1938	1939	1940	1941
Production:					
Primary: [1]					
Metallic cadmium	4,265,973	4,077,961	4,411,530	[2] 6,154,200	6,937,931
Cadmium compounds (Cd content) [3]	[2] 418,800	[2] 216,400	[2] [4] 379,000	[2] 209,400	295,600
Total primary production	[2] 4,684,800	[2] 4,294,400	[2] [4] 4,790,500	[2] 6,363,600	7,233,500
Secondary (metal and Cd content of compounds) [5]	([6])	([6])	([4] [6])	227,900	379,500
Shipments [7] by producers:					
Primary:					
Metallic cadmium	4,059,764	2,525,666	5,190,273	6,467,260	7,044,417
Cadmium compounds (Cd content) [3]	334,600	211,000	[4] 401,200	205,900	265,700
Total primary shipments	4,394,400	2,736,700	[4] 5,591,500	6,673,200	7,310,100
Secondary (metal and Cd content of compounds) [5]	([6])	([6])	([4] [6])	227,200	376,500
Imports (metallic cadmium)	828,535	22,582	309,874	27,491	[8] 147,378
Exports (metal and Cd content of compounds)	([6])	([6] [9])	([6])	387,100	[8] 103,500

[1] Figures showing primary cadmium production for 1940 and 1941 are strictly comparable. The revised data for 1937–39 are exactly comparable with 1940–41 as to totals, but in the former period the cadmium content of some compounds made from metal is included with the compounds and excluded from the metal. Production figures prior to 1937 are comparable with 1937–39 data regarding metal output but are not comparable with 1937 or later data as to compounds or totals because the earlier figures include some duplication of metal made into compounds.
[2] Revised figures.
[3] Excludes compounds made from metal.
[4] Some secondary compounds included with primary compounds. Bureau of Mines not at liberty to publish figures separately for primary cadmium compounds.
[5] Bureau of Mines not at liberty to publish figures separately for secondary cadmium compounds.
[6] Data not available.
[7] Figures for 1937–39 represent sales.
[8] Figures cover January to September, inclusive.
[9] Producers reported exports of 458,283 pounds of metallic cadmium.

Cadmium compounds are produced principally from metal, although some are made directly from primary residues and secondary materials. Total production of cadmium compounds in 1941 (in terms of Cd content) increased 56 percent over 1940.

Cadmium compounds produced in the United States, 1940–41, in pounds

Compound	1940		1941	
	Gross weight	Cd content	Gross weight	Cd content
Cadmium sulfide [1]	2,287,608	759,500	3,304,478	1,141,500
Cadmium oxide [2]	318,393	260,800	410,748	361,300
Cadmium nitrate	29,594	10,800	138,951	50,600
Cadmium hydrate	[3] 19,799	[3] 14,100	42,095	31,500
Cadmium chloride	15,475	7,600	57,828	30,100
Cadmium carbonate	14,733	9,600	36,806	24,100
Cadmium bromide	6,289	2,500	17,041	7,000
Cadmium sulfate	4,324	2,200	6,771	3,400
Cadmium iodide	(3)	(3)	4,047	1,300
Cadmium acetate	1,103	500	1,300	600
Total production	2,697,318	1,057,600	4,020,965	1,651,400

[1] Includes cadmium lithopone and cadmium sulfoselenide.
[2] In addition to quantities shown, cadmium oxide consumed in making other compounds shown was produced as follows: 1940, 33,186 pounds (Cd content, 28,700 pounds); 1941, 33,649 pounds (Cd content, 27,500 pounds).
[3] Cadmium iodide included with cadmium hydrate to avoid disclosure of confidential figures.

CONSUMPTION AND USES

Consumption of cadmium in all forms in 1941 totaled 7,766,000 pounds, a 26-percent increase over 1940. Corresponding data for earlier years are not available. About 95 percent of the available cadmium is consumed in electroplating, bearing alloys, and pigments, and the remaining 5 percent goes into miscellaneous alloys, laboratory reagents, and photographic chemicals.

Electroplating.—The most common use of cadmium is as a protective coating for steel and, to a much lesser extent, for copper alloys. The principal advantages of cadmium electrodeposits as compared with

Estimated distribution, by uses, of cadmium consumed in the United States, 1940–41

Use	1940		1941	
	Pounds	Percent of total	Pounds	Percent of total
Electroplating	3,692,000	59.8	4,586,000	59.1
Bearing alloys	1,300,000	21.0	1,504,000	19.4
Solders	73,000	1.2	130,000	1.7
Copper alloys	204,000	3.3	80,000	1.0
Zinc alloys	36,000	.6	54,000	.7
Low-melting alloys	23,000	.4	43,000	.6
Type metal	3,000	(1)	3,000	(1)
Other alloys	15,000	.2	41,000	.5
Total metal and alloys	5,346,000	86.5	6,441,000	83.0
Paints and varnishes	288,000	4.7	392,000	5.0
Ceramics (glass, porcelain enamel, pottery)	256,000	4.2	389,000	5.0
Printing inks	105,000	1.7	126,000	1.6
Rubber	50,000	.8	100,000	1.3
Laboratory reagents	44,000	.7	68,000	.9
Leather	35,000	.6	75,000	1.0
Photography	5,000	(1)	11,000	.1
Other pigments [2]	49,000	.8	164,000	2.1
Total pigments and chemicals	832,000	13.5	1,325,000	17.0
Total cadmium consumed	6,178,000	100.0	7,766,000	100.0

[1] Less than 0.1 percent.
[2] Includes plastics, textiles, artists' colors, etc., and some unclassified.

those of zinc, according to Fusco and Woldman,[1] Mankowich,[2] and Bray,[3] are as follows: (1) Coatings one-third as thick give equal protection; (2) rate of deposition is virtually double; (3) parts are more easily soldered; (4) cadmium has higher electrical conductivity; (5) when plated on one of two dissimilar alloys—such as steel and duralumin or steel and brass—that would otherwise be in contact, cadmium more effectively minimizes corrosion by galvanic action; (6) bath is more easily operated; (7) less electrical current is required; (8) cadmium has superior throwing power, that is, ability to deposit uniformly in recesses; (9) cadmium has greater resistance to atmospheric agencies, salt water, and alkalies; and (10) cadmium holds its brightness longer. Some of these properties are interrelated. A disadvantage of cadmium plating is its low resistance to many acids.

Products commonly electroplated with cadmium include bolts, nuts, screws, rivets, nails, washers, fasteners, and parts for a wide variety of products, including airplanes, ordnance, automobiles, electrical equipment (conduit fittings, switches, and controls), builders' hardware (locks, hinges, and fixtures), communication equipment (radio, telephone, and telegraph parts), office equipment (typewriter, adding-machine, and calculator parts), household appliances (vacuum-cleaner, washing-machine, stove, and refrigerator parts), hand tools (wrenches, pliers, and screw drivers), industrial hardware (chains, hose couplings, valves, hooks, filters, and pulleys), textile machinery (heddles, bobbin rings, and cotton-gin ribs), measurement and control equipment (counter, thermostat, pyrometer, and gage parts), machine tools, railway signal devices, agricultural implements, oil-drum flanges, commercial refrigerators, beverage and candy vending machines, respirators, fire-fighting apparatus, bicycles, buttons on work clothes and uniforms, fishing tackle, and toys. Many of the nonessential applications of cadmium have been discontinued for the duration of the war.

Cadmium bearing alloys.—Cadmium-base bearings are generally of two types—one composed of 98.65 percent cadmium and 1.35 percent nickel and another containing 0.?–2.25 percent silver and 0.25–2 percent copper in place of the nickel. Such bearings are used principally in automotive engines but also in aircraft and marine engines. The big end bearing of British Bristol and French Gnome-Rhone airplane engines was reported by German metallurgists to be of the first type mentioned.[4] Certain lead-antimony-tin bearing alloys contain 0.5–2 percent cadmium. Cadmium-base bearings, according to Dayton and Faust,[5] are stronger than babbitt and, compared with other connecting-rod bearings, have superior embeddability and ease of bonding but inferior seizure resistance and corrosion resistance. To protect cadmium bearings from the corrosive action of organic acids in lubricants, a coating of indium is sometimes applied. "Graphalloy"—solid graphite impregnated with 30–35 percent cadmium—is used in oilless bearings and bushing linings.

Cadmium solders.—The most widely used cadmium solders are the cadmium-silver solders, three typical compositions of which are shown

[1] Fusco, Anthony J., and Woldman, Norman E., Cadmium Plating in the Victory Program: Iron Age, vol. 149, No 12, March 19, 1942, pp. 46–52.
[2] Mankowich, A., Corrosion Resistance of Cadmium and Zinc Electrodeposits under Marine Conditions: Monthly Rev. Am. Electroplaters' Soc., vol. 27, No. 11, November 1940, pp. 833–839
[3] Bray John L., Nonferrous Production Metallurgy: John Wiley & Sons, New York, 1941, pp.65–66.
[4] Iron Age, Metallurgy of Aircraft Engines: Vol. 148, No. 26, December 25, 1941, p. 40.
[5] Dayton, R W., and Faust, C. L., The Use of Silver in Bearings; Silver in Industry: Reinhold Publishing Corporation, New York, 1940, p. 223.

in the following table. Silver solders for the jewelry trade sometimes contain 10–20 percent cadmium. The zinc-tin alloy shown is a high-temperature solder suitable, among other things, for flexible tubing. Similar alloys containing 5–43 percent cadmium are used for soldering aluminum. The war-imposed necessity for strict conservation of tin has focused attention on reduction or even elimination of tin in base-metal solders. The cadmium-lead-tin alloys in the table appear the most promising of the low-tin solders, according to Rhines and Anderson,[6] who discuss the technical advantages and disadvantages of a number of cadmium solders. These investigators point out that base-metal solders containing no tin are distinctly less promising than those containing reduced quantities, but that the first two tinless compositions in the following table deserve special notice. The third tinless solder listed is one of the best, states Gillett,[7] for it resembles lead-tin in ease of application and makes good joints. It is alleged to be the favorite German substitute solder.

Cadmium solder compositions, in percent

Type	Cadmium	Silver	Zinc	Lead	Tin	Copper	Nickel
Silver-cadmium	5	20	30			45	
	95	5					
	16	50	16			15	3
Zinc-tin-cadmium	22.5		71		5	1.5	
Lead-tin-cadmium	26			65	9		
	22			75	3		
Tinless-cadmium	10–26			65–80			
	40		60				
	8		2	90			

Other cadmium alloys.—The addition of about 1 percent cadmium to copper trolley wire improves strength and wear resistance without seriously reducing electrical conductivity. Small quantities of cadmium-copper have also been used in electrical contact parts of horn relays and voltage regulators for automobiles. An alloy of 60 percent cadmium and 40 percent zinc is sold for hot-dipping wire. Some wire is dipped in a bath of 33 percent cadmium and 67 percent zinc. Photoengravers use zinc alloys containing 0.3 percent cadmium to improve etching characteristics. "Cerrobend," a low-melting alloy of 50 percent bismuth, 27 percent lead, 13 percent tin, and 10 percent cadmium, is used in the aircraft industry as a filler in bending thin-walled tubing and as a material for making spotting fixtures and jigs. Other low-melting alloys containing 39–50 percent bismuth, 19–38 percent lead, 11–24 percent tin, and 4–25 percent cadmium are used in sprinkler apparatus, fire-detector systems and valve seats for high-pressure gas containers. About 0.4 percent cadmium is added to some type metals to improve castability. Cadmium-carbon and cadmium-silver are made into contacts for circuit breakers and other electrical equipment. Small quantities of cadmium are used in slider fasteners, collapsible tubes, standard cells, pattern metal for stoves, low-carat gold alloys, and wire-quenching mediums, and as a deoxidizing agent in silver melting.

Cadmium compounds.—Cadmium sulfide and cadmium sulfoselenide are standard agents for producing resistant yellow and red colors,

[6] Rhines, F. N., and Anderson, W. A., Substitute Solders: Metals and Alloys, vol. 14, No. 5, November 1941, pp. 704–711.

[7] Gillett, H. W., Substitutes for Tin in Solder: Nat. Acad. Sciences Rept. 45 to the War Production Board, March 26, 1942, 13 pp.; abs. Metals and Alloys, vol. 15, No. 5, May 1942, p. 868.

respectively, in paints, ceramics, inks, rubber, leather, and other products. Virtually all the cadmium oxide, hydrate, and chloride produced go into platers' electrolytic solutions. Cadmium bromide, chloride, and iodide are used in photographic films.

STOCKS

Producers' stocks of cadmium during 1941 decreased 12 percent—the result of a 19-percent decline in metallic cadmium and a 50-percent gain in cadmium compounds (based upon Cd content). Inventories held by cadmium-compound manufacturers (consumers of metal in making compounds for sale) and suppliers (dealers plus distributors that cast metal into anode shapes) decreased 53 percent and 32 percent, respectively, during 1941. Consumers' stocks of cadmium in the first half of 1941 declined 11 percent but showed a net gain of 5 percent for the year. Metals Reserve Co., a subsidiary of the Reconstruction Finance Corporation, began a Government stock pile of metallic cadmium in 1941 and had on hand 134,400 pounds as of October 22 of the year.

Cadmium stocks at end of 1940 and 1941, in pounds

	December 31, 1940			December 31, 1941		
	Metallic cadmium	Cadmium compounds (Cd content)	Total cadmium	Metallic cadmium	Cadmium compounds (Cd content)	Total cadmium
Producers	552, 130	66, 700	618, 800	444, 944	100, 300	545, 200
Compound manufacturers	171, 292	234, 000	405, 300	57, 677	134, 400	192, 100
Suppliers	202, 587	52, 500	255, 100	95, 894	77, 200	173, 100
Consumers [1]	1, 501, 000	64, 000	1, 565, 000	1, 536, 000	106, 000	1, 642, 000
Government				[2] 134, 400		[2] 134, 400
Total stocks	2, 427, 000	417, 200	2, 844, 200	2, 268, 900	417, 900	2, 686, 800

[1] Partly estimated. Includes some material in process. Excludes stocks of compounds held by pigment and chemical consumers.
[2] Stocks on Oct. 22, 1941. Data for Dec. 31, 1941, are not available for publication.

PRICES

The 1941 opening price of 80 cents a pound for commercial sticks of metallic cadmium advanced 5 cents on February 17 and again on March 7 to 90 cents a pound, where it remained the rest of the year. Anode shapes continued to command a premium of 5 cents a pound. The tight position in plating metals enabled certain dealers to sell cadmium at prices as high as $1.75 a pound—a practice that on April 11 brought a charge of "ruthless profiteering" and a warning of ceiling prices from Leon Henderson, Commissioner of Price Stabilization, Office of Emergency Management. On August 30 Henderson, now Administrator, Office of Price Administration, announced that the major producers of cadmium had indicated their willingness to continue to sell the metal to consumers at prices not above 90 cents for sticks and 95 cents for anodes and to sell to distributors at discounts permitting resales at the same prices. This agreement, which was adhered to by primary producers but not by certain secondary producers, was made mandatory by Office of Price Administration Price Schedule 71, effective January 19, 1942. The order was

amended, effective June 22, 1942, to permit the sale of metallic cadmium in small containers (5 pounds or less) at October 1941 price levels.

Shipments of metallic cadmium, as reported to the Bureau of Mines by primary producers, had an average value of 78 cents a pound in 1941 compared with 70 cents in 1940, 53 cents in 1939, 74 cents in 1938, and $1.12 in 1937. Producers' quotations, according to Metal and Mineral Markets, averaged 88 cents in 1941 compared with 80 cents in 1940 and 59 cents in 1939.

Cadmium compounds also advanced in price during 1941—cadmium sulfide from 75 cents a pound to $1.10 in April and cadmium lithopone from 50–60 cents a pound to 55–65 cents in November, according to Oil, Paint and Drug Reporter.

FOREIGN TRADE [8]

Imports.—Imports of metallic cadmium in 1937–41 are shown in the following table. Virtually all of the metal entered from Canada in the first 9 months of 1941 was purchased by a French company and, as a result of the collapse of France, was resold to the Metals Reserve Co. A few hundred pounds of cadmium sulfide from the United Kingdom represented the total cadmium-compound entries reported in the first 9 months of 1941. Corresponding data on cadmium-compound imports in previous years are not available. Domestic cadmium production is partly from imported flue dust, which in the first 9 months of 1941 had a cadmium content of 1,707,022 pounds, including 1,370,294 from Mexico, 334,137 from South-West Africa, and 2,591 from the Union of South Africa. All flue dust imported in 1940 was from Mexico and contained 1,890,528 pounds of cadmium.

Metallic cadmium imported for consumption in the United States, 1937–41

Country	1937		1938		1939		1940		1941 (Jan.-Sept.)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Australia	22,400	$41,440								
Belgium	250,878	301,663	20,067	$28,815	197,454	$84,904	27,491	$9,520		
Canada	270,620	354,014			30,068	14,642			136,280	$139,898
France	3,968	5,753								
Germany	34,562	32,092	55	163	50	148				
Italy			2,240	1,406	35,304	14,847				
Netherlands	2,205	4,079			38,038	12,649				
Norway	76,940	117,224			6,720	2,822				
Poland and Danzig	27,557	19,077	220	190	2,240	961				
United Kingdom	139,405	199,988							11,098	12,166
	828,535	1,075,330	22,582	30,574	309,874	130,973	27,491	9,520	147,378	152,064

Exports.—Cadmium exports in the first 9 months of 1941 totaled 103,500 pounds, including 46,516 pounds of metal and 57,000 pounds in compounds. Exports in 1940 comprised 286,529 pounds of metal and 100,600 pounds in compounds—a total of 387,100 pounds. These figures were obtained by the Bureau of Mines from exporters, and corresponding data for previous years are not available. The Department of Commerce, which had previously recorded data on

[8] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

cadmium exports in combination with other commodities, began to show them separately on July 1, 1941.

TOXICOLOGY

Dangers to health are involved in the production of cadmium and in the consumption of food contaminated with cadmium. Regarding the former, Frant and Kleeman [9] state: "Cadmium presents its greatest hazard to the health of man during its production and in the handling of its compounds. Most dangerous are the inhalation of fumes and vapors arising from retorts or condensers while cadmium and cadmium oxide are being manufactured and the inhalation of dust in bagging and handling the materials." In a number of instances inhalation of cadmium fumes has resulted in death. The safe limit of cadmium vapor in air is stated to be 0.1 milligram per cubic meter. The determination of cadmium in quantities as small as 0.025 to 0.05 milligram by a method suitable for industrial-hygiene studies is described by Feicht, Schrenk, and Brown [10], of the Bureau of Mines.

Several outbreaks of cadmium food poisoning induced the Federal Security Agency to advise manufacturers against using the metal for plating cooking utensils and refrigerator containers, according to an announcement by Federal Security Administrator Paul V. McNutt on January 14, 1942. The suggestion was implemented by action of the Office of Production Management, which stated that no cadmium would in future be released for such uses. New York City amended its Sanitary Code to prohibit the use of cadmium in articles employed in the preparation of food and drink. Most of the reported cases [11] of cadmium poisoning resulted from placing gelatin desserts and beverages containing fruit juices in cadmium-plated refrigerator trays. Cadmium was applied to the trays not by manufacturers but by reconditioners who sold the refrigerators second-hand. Cadmium-plated pitchers, beverage cans, roasting pans, and molds for "popsicles" (flavored ices frozen on a stick) also have caused food poisoning. Cadmium compounds combine with hydrochloric acid in the gastric juices to form toxic cadmium chloride, resulting in violent acute gastritis with nausea, cramps, vomiting, diarrhea, and weakness. Symptoms may appear within 10 minutes after ingestion of the contaminated food. Cadmium in concentrations as low as 15 parts per million produces noticeable effects. However, no fatal cases of cadmium food poisoning and no instances of chronic poisoning due to continued ingestion of minute amounts of cadmium have ever been reported.

WORLD ASPECTS OF CADMIUM INDUSTRY

Some general comments on the world cadmium situation appear in the opening paragraph of this chapter. Cadmium production of individual countries in recent years is shown in the following table.

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[9] Frant, Samuel, and Kleeman, Irving, Cadmium "Food Poisoning": Jour. Am. Med. Assoc., vol. 117, No. 2, July 12, 1941, pp. 86–89; repr. Metal Finishing, vol. 40, No. 3, March 1942, pp. 131–134.

[10] Feicht, Florence L., Schrenk, H. H., and Brown, Carlton E., Determination by the Dropping-Mercury-Electrode Procedure of Lead, Cadmium, and Zinc in Samples Collected in Industrial-Hygiene Studies: Bureau of Mines Rept. of Investigations 3639, 1942, pp. 1–20.

[11] Frant, Samuel, and Kleeman, Irving, Work cited in footnote 9.

Calvery, Herbert O., Illnesses Traced to Cadmium Food Containers. Metal Finishing, vol. 40, No. 3, March 1942, pp. 134–135.

World production of cadmium, 1936–41, by countries, in kilograms

[Compiled by B. B. Waldbauer]

Country	1936	1937	1938	1939	1940	1941
Australia (Tasmania)	251,826	210,608	199,826	175,150	(1)	(1)
Belgium	203,997	271,000	182,000	[2] 530,800	(1)	(1)
Canada	356,484	338,018	317,122	426,234	(1)	(1)
France	84,000	99,000	116,000	(1)	(1)	(1)
Germany	302,000	355,000	432,000	(1)	(1)	(1)
Italy	54,630	90,850	69,000	(1)	(1)	(1)
Japan	23,563	(1)	(1)	(1)	(1)	(1)
Mexico [3]	535,017	619,792	762,398	816,584	815,734	906,577
Norway	101,876	154,192	207,667	138,000	(1)	(1)
Poland	140,900	124,461	244,000	(1)	(1)	(1)
South-West Africa [3]	97,472	132,763	259,133	82,155	39,634	[4] 179,597
U. S. S. R.	50,000	50,000	50,000	(1)	(1)	(1)
United Kingdom	22,160	124,142	124,898	(1)	(1)	(1)
United States:						
Metallic cadmium	1,648,117	1,935,003	1,849,722	2,001,026	[5] 2,791,484	3,146,976
Cadmium compounds (Cd content)	[5] 147,200	[5] 190,000	[5] 98,200	[5] 171,900	[5] 95,000	134,000
	3,386,800	3,942,300	3,889,900	(1)	(1)	(1)

[1] Data not available.
[2] Exports.
[3] Cadmium content of flue dust exported for treatment elsewhere; represents in part shipments from stocks on hand. To avoid duplication of figures, the data are not included in the total.
[4] Figures cover January to June, inclusive.
[5] Revised figures.

Belgium.—Produits Chimiques de Tenderloo S. A., whose plant was reported seriously damaged by an explosion early in 1942, was a producer of cadmium and cadmium salts.[12]

Canada.—Production of cadmium in 1941 was stepped up 37 percent over 1940 by Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, British Columbia—the Dominion's principal source of this metal. Hudson Bay Mining & Smelting Co., Flin Flon, Manitoba—the other Canadian cadmium producer—increased its milling capacity about 14 percent during 1941 and in September put into operation a 10-ton pilot plant to test a process for treating stock-piled residues containing zinc, cadmium, and other metals.[13] Canada is not only producing enough cadmium for its own requirements, according to a statement by the Metals Controller's Office,[14] but has a surplus to send to the United Kingdom and the United States. Primary cadmium may be acquired only under permit from the Metals Controller, according to an order effective June 1, 1942. Metallic cadmium, ton lots, was quoted at $1.15 a pound at the beginning of 1941, according to Canadian Metals & Metallurgical Industries, but advanced in March to $1.25 and in April to $1.30, where it remained the rest of the year.

Mexico.—Cadmium flue-dust production (based upon Cd content) was 11 percent larger in 1941 than in 1940. Cadmium flue dust was exported to the United States for production of metal and compounds.

Peru.—A cadmium recovery plant was under construction early in 1942 at the Cerro de Pasco Copper Corporation smelter in Oroya.[15]

[12] Metal Bulletin (London), No. 2691, May 8, 1942, p. 9.
[13] Canadian Mining Journal, vol. 63, No. 2, February 1942, p. 95.
[14] Northern Miner, vol. 27, No. 47, February 12, 1942, p. 7.
[15] Huttl, John B., A Mining Tour of South America: Eng. and Min. Jour., vol. 143, No. 6, June 1942, p. 49.

South-West Africa.—Cadmium flue dust is a byproduct of the smelting of copper-lead-zinc ores from the Tsumeb mine. The property was not worked during 1941, but in the first half of the year all remaining stocks of cadmium flue dust (containing 36 percent Cd) were shipped to the United States.

Sweden.—All local stocks of cadmium bars, rods, and anodes were requisitioned by the Swedish Government on November 1, 1941.

United Kingdom.—The purchase of cadmium metal, residues, and scrap (containing over 50 percent Cd) in the United Kingdom except by license of the Minister of Supply is prohibited by Control of Nonferrous Metals Order 6 (Cadmium), issued December 24, 1941, and effective January 1, 1942. Consumers of 10 pounds or less a month are exempt from the license requirement. The order also established a maximum price for cadmium ingots, sticks, and rods (99.9 percent Cd) at 5 s. 4 d. a pound in hundredweight lots and 5 s. 6 d. in smaller quantities.

PLATINUM AND ALLIED METALS

By H. W. Davis

SUMMARY OUTLINE

SUMMARY

Chiefly as a result of refining concentrates from Canada and crude platinum from Alaska, most of which heretofore has been done in England, recoveries of new platinum metals by refiners in the United States amounted to 152,623 ounces in 1941—a new record. Recoveries of new platinum metals gained 222 percent over 1940 and 80 percent over the former peak attained in 1926. Refinery capacity has been increased to handle larger quantities of Canadian concentrates. Production of domestic placer platinum metals was 26,821 ounces in 1941, a 21-percent decline from 1940. Sales of platinum metals to consumers in the United States advanced to 288,397 ounces in 1941 from 206,890 ounces in 1940. A greater quantity of platinum metals was used in industrial products and equipment than in jewelry in 1941. Imports of platinum metals established a new peak in 1941 and amounted to 309,995 ounces, an increase of 58 percent over 1940 and 1 percent over the previous record made in 1939. On the other hand exports of unmanufactured platinum metals were only 15,405 ounces in 1941, or 72 percent less than in 1940.

Despite the greatly increased demand for platinum metals in 1941, prices remained virtually unchanged throughout the year for all metals except iridium, which was reduced $100 an ounce in February.

Salient statistics of platinum and allied metals in the United States, 1940–41, in troy ounces

	1940	1941
Production:		
Crude platinum from placers	33,800	[1] 26,821
New metals.		
Platinum	[2] 38,951	[2] 98,376
Palladium	4,564	49,812
Other	3,824	4,435
	47,339	152,623
Secondary metals.		
Platinum	47,657	37,522
Palladium	14,773	12,630
Other	4,000	1,417
	66,430	51,569
Stocks in hands of refiners, importers, and dealers, Dec. 31:[3]		
Platinum	[3] 144,302	150,887
Palladium	[3] 93,244	138,014
Other	[3] 32,368	33,942
	[3] 269,914	322,843
Imports for consumption:		
Platinum	126,696	254,714
Palladium	60,204	46,099
Other	8,745	9,182
	195,645	309,995
Exports:		
Ore and concentrates	(4)	244
Unmanufactured	55,027	15,405
Manufactures (except jewelry)	1,800	3,204

[1] Subject to revision.
[2] In 1941 includes 17,027 ounces (8,427 in 1940) of new platinum from domestic sources, comprising 15,219 ounces (3,957 in 1940) derived from crude placer platinum, 3 ounces (none in 1940) from ore, and 1,805 ounces (4,470 in 1940) obtained from domestic gold and copper ores as a byproduct of refining.
[3] In 1940 figures exclude stocks held in United States by dealers and importers other than from the United Kingdom.
[4] Not separately classified.

Because of the demand for iridium for use in contact points for magnetos, voltage regulators, and other electrical applications in the war program, the Office of Production Management on July 3, 1941, requested the voluntary cooperation of refiners and others in discontinuing the use of iridium in platinum alloys for jewelry articles and in substituting 5 percent ruthenium-platinum alloys. Effective December 12, 1941, however, the use of iridium and its alloys in the manufacture of jewelry was prohibited under Conservation Order M-49.

Because of an insufficient supply of rhodium for war and essential civilian requirements, its use in the manufacture of jewelry was prohibited by the War Production Board under Conservation Order M-95, effective March 11, 1942. This order was amended April 1, 1942, to prohibit the use of rhodium alloys, as well as rhodium plating, in the manufacture of jewelry and other articles of personal adornment.

To prevent any American platinum from being smuggled out of the country or otherwise finding its way into enemy hands, all traffic in platinum except that conducted through normal, approved trade channels was halted by the War Production Board under general Conservation Order M-162, effective May 30, 1942.

CRUDE PLATINUM

Production.—Mine returns for 1941 indicate a production of 25,400 ounces of crude platinum (containing 22,630 ounces of platinum-group metals valued at $813,000) in Alaska,[1] 1,300 ounces in California, 41 ounces in Montana, and 80 ounces in Oregon—a total of 26,821 ounces; comparable figures for 1940 are 32,300 ounces of crude platinum (containing 28,886 ounces of platinum-group metals valued at $1,093,000) in Alaska, 1,400 ounces in California, 31 ounces in Montana, and 69 ounces in Oregon—a total of 33,800 ounces. Production in Alaska came mainly from placer deposits in the Goodnews district of southwestern Alaska; most of it was mined by a large modern dredge and by well-mechanized draglines. In California most of the output of platinum was a byproduct of dredges working the gold placers in Amador, Butte, Merced, Placer, Sacramento, San Joaquin, Shasta, Stanislaus, Trinity, and Yuba Counties. Production in Montana was from Lewis and Clark and Sanders Counties. Production in Oregon came from Baker, Grant, Jackson, and Josephine Counties.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1941, 6,494 ounces of platinum metals were recovered as a byproduct of refining gold and copper ores compared with 7,774 ounces in 1940

The Goodnews (Alaska) platinum deposits have been described by Mertie.[2] The report covers the geography, general geology, and economic geology of the platinum deposits and is illustrated with topographic and geologic maps. It includes 28 commercial analyses of platinum metals of Fox Gulch and Platinum Creek, 8 of Squirrel Creek, 47 of Lower Platinum Creek and Salmon River, and 1 of Clara Creek.

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1941: Alaska, 25,752 ounces; California, 1,129 ounces; Montana, 10 ounces;

[1] Figures and other information for Alaska from Geol. Survey, U. S. Dept. of Interior.
[2] Mertie, J. B., Jr., The Goodnews Platinum Deposits, Alaska: Geol. Survey Bull. 918, 1940, 97 pp.

and Oregon, 126 ounces—a total of 27,017 ounces (6,006 ounces in 1940). Domestic refiners also reported purchases of 38,124 ounces (34,374 ounces in 1940) of foreign crude platinum or osmiridium in 1941—10 ounces from Canada, 37,790 ounces from Colombia, 224 ounces from Australia, and 100 ounces from the Union of South Africa.

Prices.—Buyers reported purchases at $28.39 to $73.28 an ounce for domestic crude platinum and $24.80 to $191.50 an ounce for foreign crude platinum or osmiridium in 1941.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, nickel, and copper indicate that 152,623 ounces of platinum metals were recovered in the United States from such sources in 1941, an increase of 222 percent over 1940 and 80 percent over the previous record made in 1926. It is estimated that 22,683 ounces of the total output in 1941 were derived from domestic sources.

New platinum metals recovered by refiners in the United States in 1941, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
Domestic from—							
Crude platinum	15,219	9	637	206	24	79	16,174
Ore	3	10	2				15
Gold and copper refining	1,805	4,645	33	11			6,494
	17,027	4,664	672	217	24	79	22,683
Foreign from—							
Crude platinum Nickel and copper refining	81,349	45,148	720	47	1,956	720	129,940
Total recovery	98,376	49,812	1,392	264	1,980	799	152,623

New platinum metals recovered by refiners in the United States, 1937–41, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1937	36,174	5,945	1,998	1,141	45,258
1938	30,444	3,653	1,247	869	36,213
1939	36,033	3,491	1,051	866	41,441
1940	38,951	4,564	1,517	2,307	47,339
1941	98,376	49,812	1,392	3,043	152,623

Secondary metals recovered.—In 1941, 51,569 ounces of secondary platinum metals were recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum, a 22-percent decrease from 1940.

Secondary platinum metals recovered in the United States, 1937–41, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1937	55,926	12,680	2,076	1,524	72,206
1938	44,654	13,489	1,253	4,895	64,291
1939	45,432	13,039	2,767	2,205	63,443
1940	47,657	14,773	1,365	2,635	66,430
1941	37,522	12,630	659	758	51,569

Prices.—Except for iridium, quotations [3] on platinum metals were stable throughout 1941. Platinum was quoted at $36 an ounce, palladium $24, osmium $45 to $48, rhodium $125, and ruthenium $35 to $40. Iridium was quoted at $275 an ounce during January and at $175 the remainder of the year. The quotations on palladium, rhodium, and ruthenium have prevailed for several years.

Consumption and uses.—Platinum and its allied metals (palladium, iridium, rhodium, ruthenium, and osmium) are characterized by high melting point, whiteness, and resistance to oxidation at high temperatures and to attack by destructive chemical compounds. As pure metals, combined, clad, or alloyed with other metals, the platinum metals are employed in jewelry and dentistry, in the chemical and electrical industries, and for numerous miscellaneous purposes.

A material gain in world output of platinum metals, owing chiefly to improvements in metallurgical processes for refining copper-nickel ores, has made available large quantities of platinum, palladium, iridium, rhodium, ruthenium, and osmium. In 1938—the latest year for which fairly complete figures are available—world production of platinum metals was about 540,000 ounces, of which 57 percent was recovered as byproducts in the refining of nickel, copper, and gold ores, whereas in 1929 world production was about 231,000 ounces, of which 17 percent was so obtained. With increased supplies, relative stability in the price of platinum and palladium has been reached at levels that permit their use for plant equipment and other industrial purposes. Despite the rapid advance in output of platinum metals during the past decade, research has found new uses for them, and developmental activities are opening up larger and more diversified markets in which they are becoming accepted.

The most widely used metal of the group is platinum, which constituted 190,075 ounces (66 percent) of the total platinum metals reported sold to consumers in the United States in 1941. The chemical industry, which usually ranks second as a consumer of platinum, advanced to first place in 1941, taking 36 percent (68,285 ounces) of the total platinum sales. The largest outlet for platinum in the chemical industry in 1941 was as a catalyst to produce nitric and sulfuric acids, which are consumed in large quantities for the manufacture of explosives and other war materials. Important quantities of platinum were also used in laboratory ware and rayon spinnerets. Smaller amounts were employed in nozzles for the production of glass fiber, lining processing and reaction vessels, hydrogenation of organic compounds, glass insulators for the bases of electric-light bulbs, tubing, valves, siphons, and safety disks for handling corrosive liquids and gases, anodes for the production of "per" salts, gas-analysis cells, and crucibles.

The jewelry industry dropped from first to second place as a consumer of platinum in 1941. Alloyed with iridium or ruthenium, platinum is employed as a setting for diamonds and other precious stones in rings and other forms of jewelry. About 35 percent (66,151 ounces) of the total sales of platinum went to the jewelry trade in 1941.

Accounting for 15 percent (28,368 ounces) of the total platinum sales in 1941, the electrical industry ranked third. Platinum is used in this industry for thermocouples, temperature measuring and re-

[3] Engineering and Mining Journal Metal and Mineral Markets, vol. 12, 1941.

cording instruments, precision resistance thermometers, high-temperature furnace windings, spark-plug electrodes, magneto contacts, electrical contacts, relays, thermostats, automobile voltage regulators and direction indicators, and switches for potentiometric recorders.

The dental industry purchased 10 percent (19,426 ounces) of the total platinum sold in the United States in 1941. Platinum, either pure or alloyed, is used in tooth pins, bridges, and bracing for artificial teeth, as matrices on porcelain inlays, and in orthodontic appliances.

Next to platinum, palladium is the most extensively used metal of the group; it is about half as common as platinum but less costly. It constituted 78,904 ounces (27 percent) of the total platinum metals sold to domestic consumers in 1941. Palladium, pure or alloyed, is adapted to many of the uses of platinum and during the past 2 decades has been employed in increasing quantities by the dental, electrical, and jewelry industries. The conservation of gold by many countries has stimulated the demand for platinum metals, particularly palladium, and the substitution of palladium for gold alloys for dental restorations and articles of jewelry has made substantial progress. Palladium in telephone relays and other types of electrical contacts found an improved market in the electrical field; in consequence,the electrical industry was the chief consumer in 1941, taking 45 percent (35,456 ounces) of the total palladium sold. Second in magnitude as a consumer of palladium is the dental industry, which took 40 percent (31,440 ounces) of the total. The jewelry industry was the third-largest outlet for palladium in 1941, and small quantities were sold for use in the manufacture of chemical ware.

The consumption of the other platinum metals—iridium, rhodium, osmium, and ruthenium—is comparatively small; it made up 7 percent of the total for the group in 1941. Iridium is used chiefly as a hardening addition to platinum, rendering it suitable for laboratory vessels, rayon spinnerets, surgical tools, hypodermic needles, magneto and electrical contacts, and jewelry. Its compounds are employed as fixing agents, porcelain pigment, and (in the form of black) as a catalyst. Rhodium is alloyed with platinum for high-melting-point thermocouple wire, furnace windings, and laboratory ware for certain special applications, and for use as a catalyst to produce sulfuric acid and for ammonia oxidation to produce nitric acid and nitric oxide. Rhodium plating is employed as a finish for glassware and silverware and in surfacing reflectors for searchlights and projectors. Osmium, in association with other metals, provides pen points that will resist wear and corrosion by ink. Considerable osmium was used in electrical contact points in 1941. Osmium alloys also replace jewels as bearings for fine instruments. The oxide is used as a biological stain for fats and for fingerprint work. Ruthenium, like iridium, is an effective hardening agent for platinum and palladium, and one of its salts serves as a biological stain. Because of the demand for iridium in the aircraft industry, much ruthenium was employed as a hardener of platinum in jewelry and electrical contact points in 1941.

The following table shows sales of platinum metals by refiners, importers, and dealers to consumers in the United States in 1941. Such sales totaled 288,397 ounces.

Platinum metals sold to consuming industries in the United States in 1941, in troy ounces

Industry	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
Chemical	68,285	3,342		
Electrical	28,368	35,456		
Dental	19,426	31,440	19,418	288,397
Jewelry	66,151	7,999		
Miscellaneous and undistributed	7,845	667		
	190,075	78,904	19,418	288,397

Stocks.—Stocks of platinum metals in the hands of refiners, importers, and dealers were 322,843 ounces on December 31, 1941.

Stocks of platinum metals held by refiners [1] in the United States, December 31, 1937–41, in troy ounces

Year	Platinum	Palladium	Iridium	Osmium, rhodium, and ruthenium	Total
1937	60,236	21,942	8,846	8,475	99,499
1938	71,058	30,071	7,151	9,631	117,911
1939	71,393	29,273	7,000	9,884	117,550
1940 [1]	144,302	93,244	32,368		269,914
1941 [1]	150,887	138,014	33,942		322,843

[1] In 1940 figures also include stocks held in the United States by importers from the United Kingdom; in 1941 figures also include stocks held in the United States by all importers and dealers.

FOREIGN TRADE [4]

Imports.—Imports of platinum metals into the United States during 1941 established a new record and amounted to 309,995 ounces, a gain of 58 percent over 1940 and 1 percent over the previous peak year 1939. The principal sources of imported platinum metals in 1941 were Canada (217,909 ounces), United Kingdom (52,377 ounces), and Colombia (36,875 ounces). Imports of unrefined platinum (excluding scrap) increased phenomenally to 226,951 ounces in 1941 from 58,320 ounces in 1940, whereas imports of refined platinum (including scrap) declined to 27,763 ounces in 1941 from 68,376 ounces in 1940. Although receipts of iridium advanced to 1,292 ounces in 1941 from 237 ounces in 1940, they fell far short of the imports during the 5 years 1935–39, which averaged 4,354 ounces. Imports of osmiridium dropped to 266 ounces in 1941 from 1,857 ounces in 1940 and from an average of 3,380 ounces during the 5 years 1935–39. Imports of osmium and ruthenium increased 4 and 118 percent, respectively, over 1940, but palladium and rhodium decreased 23 and 22 percent, respectively.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Platinum metals imported for consumption in the United States, 1937–41

Year	Troy ounces	Value	Year	Troy ounces	Value
1937	206,937	$7,418,364	1940	195,645	$5,748,005
1938	161,189	4,366,912	1941	309,995	7,143,612
1939	306,627	9,881,531			

Platinum metals (unmanufactured) imported for consumption in the United States, 1940–41, by metals

Metal	1940		1941	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores and concentrates of platinum metals (platinum content)	13,653	$314,400	175,810	$3,317,809
Grain and nuggets (including crude, dust, and residues) (platinum content)	44,667	1,215,683	51,141	1,300,601
Sponge and scrap (platinum content)	32,734	1,250,016	17,898	635,062
Ingots, bars, sheets, or plates not less than ⅛-inch thick (platinum content)	35,642	1,175,827	9,865	322,989
	126,696	3,955,926	254,714	5,576,461
Iridium	237	38,774	1,292	279,455
Osmiridium	1,857	64,851	266	23,851
Osmium	1,617	57,064	1,689	58,028
Palladium	60,204	1,256,696	46,099	851,174
Rhodium	3,586	333,217	2,780	271,809
Ruthenium	1,448	41,477	3,155	82,834
	195,645	5,748,005	309,995	7,143,612

Platinum metals (unmanufactured) imported for consumption in the United States in 1941, by countries, in troy ounces

Country	Platinum				Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores and concentrates of platinum metals (platinum content)	Grain and nuggets (including crude, dust, and residues) (platinum content)	Sponge and scrap (platinum content)	Ingots, bars, sheets, or plates not less than ⅛-inch thick (platinum content)					
Argentina		488	93				4		585
Australia						191			191
Belgium			88						88
Brazil			35						35
Canada	175,780	12,750	1,330	18	1		25,020	3,010	217,909
Colombia		36,873	2						36,875
France			660						660
Germany			1						1
New Zealand			3						3
Philippine Islands	30								30
Portugal				150					150
U. S. S. R.					1,000				1,000
United Kingdom		1,000	15,686	9,697	291	1,764	21,014	2,925	52,377
Uruguay		30					61		91
West Indies, British			(1)						(1)
	175,810	51,141	17,898	9,865	1,292	1,955	46,099	5,935	309,995

[1] Less than 1 troy ounce.

Exports.—Exports of unmanufactured platinum metals declined phenomenally to 15,405 ounces in 1941 from 55,027 ounces in 1940 and from an average of 48,746 ounces during the 4 years 1936–39. The shipment of 8,100 ounces to U. S. S. R. in 1941 was refined platinum from stock held by the Amtorg Trading Corporation. Except for U. S. S. R., Canada (3,041 ounces) and Argentina (1,577 ounces) were the chief foreign markets for unmanufactured platinum metals in 1941.

Platinum and allied metals exported from the United States, 1937–41

Year	Ore and concentrates		Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1937	(1)	(1)	59,567	$2,908,552	2,874	$100,944
1938	(1)	(1)	33,635	1,156,644	796	31,111
1939	(1)	(1)	46,329	1,528,563	4,041	213,445
1940	(1)	(1)	55,027	2,280,339	1,800	96,703
1941	244	$11,713	15,405	607,333	3,204	160,674

[1] Not separately classified.

Platinum and allied metals exported from the United States in 1941, by countries [1]

Country	Ore and concentrates [2]		Unmanufactured (ingots, sheets, wire, alloys, and scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
Argentina			1,577	$54,024	3	$900
Brazil	48	$1,830	343	12,711	221	8,828
Canada	10	358	3,041	138,856	2,432	121,402
Chile	16	576	193	7,720	28	1,589
Cuba	2	116	399	10,240	8	456
Egypt					150	4,550
Japan			843	27,586		
Mexico			93	3,712	17	917
Netherlands Indies			150	5,846	30	1,616
Philippine Islands			70	4,510	12	353
Spain			80	2,682		
Union of South Africa	38	3,125	2	60	22	2,102
U. S. S. R.			8,100	324,000		
United Kingdom	128	5,628	260	8,819		
Uruguay			168	3,386	73	2,545
Other countries	2	80	86	3,181	208	15,416
	244	11,713	15,405	607,333	3,204	160,674

[1] Figures for 1940 in Minerals Yearbook, Review of 1940, p. 739, should read—Manufactures of, except jewelry: China, 7 ounces, $322; Japan, 522 ounces, $27,697. No change in grand totals.
[2] Not separately classified before January 1, 1941.

WORLD PRODUCTION

Because of Government restrictions in many countries on the publication of statistics, few figures for 1940 and 1941 are available. However, data on world production of platinum metals by countries are fairly complete for 1936, 1937, 1938, and 1939; they are shown in Minerals Yearbook, Review of 1940, page 739.

Canada.—Figures are not available on the recovery of platinum metals from the nickel-copper ores of the Sudbury district, Ontario, in 1940 and 1941, but 148,877 ounces of platinum and 135,402 ounces of other platinum-group metals were recovered in 1939. Concentrates from the Port Colborne and Copper Cliff refineries and residues from

the Clydach (South Wales) refinery are normally shipped to the International Nickel Co. precious metals refinery at Acton, England, for recovery of platinum, palladium, iridium, rhodium, and ruthenium. Since 1940, however, much of the concentrates has been shipped to the United States for refining.

Colombia.—The South American Gold & Platinum Co. produced 30,548 ounces of crude platinum metals in 1941 (24,294 in 1940) and 72,582 ounces of gold (58,462 in 1940). The figures for other operators are not available.

In accordance with Decree 796, issued March 27, 1942, by the Colombian Government, all platinum production in Colombia must be sold to the Bank of the Republic.

Union of South Africa.—The estimated content of the platinum metals (exclusive of osmiridium) produced in the Union of South Africa was 71,975 ounces in 1940. Figures for 1941 are not available, but according to the South African Mining and Engineering Journal [5] "the report of Rustenburg Platinum Mines for the 12 months ended 31st August discloses that production to the full capacity of the plant proceeded uninterruptedly during the year, and the output in the form of crude platinoids and matte was dispatched to England for treatment."

[5] South African Mining and Engineering Journal, vol. 52, No. 2550, December 13, 1941, p. 436.

MINOR METALS

By Allan F. Matthews [1]

SUMMARY OUTLINE

GENERAL STATEMENT

Initiation of a $7,750,000 project to make the United States self-sufficient in ilmenite supplies, subjection of virtually all metals to various degrees of Government control, and greatly increased production and consumption were the 1941 highlights of the metals regularly reviewed in this chapter. Calcium-silicon and titanium pigments were the only derivatives of the minor metals placed under priority order by the Office of Production Management in 1941 and early 1942. Titanium pigments were also subject to price control by the Office of Price Administration. On the other hand, most of the minor metals were under export control—specifically beryllium, cerium, columbium, radium, tantalum, thorium, titanium, uranium, and zirconium. On December 28, 1941, in accordance with Office of Production Management Order M-63, the Metals Reserve Co., subsidiary of the Reconstruction Finance Corporation, assumed control of all imports of rutile and zircon.

BERYLLIUM

Annual world production of beryl is estimated to have increased from 500 short tons in 1935 to 1937 and 1,000 tons in 1938 and 1939 to 2,500 tons in 1940. Appreciable advances in output were also registered during 1941. The principal sources of beryl are Argentina and Brazil. The United States, Germany, and Italy are the outstanding producers of beryllium metal, alloys, and compounds, but some output has been reported in France and Japan. The Axis Powers in recent years have acquired more than one-third of the beryl available in world markets. Beryllium alloys have many very desirable properties, and they are being utilized in ever-increasing quantities, but the trend is restricted by relatively high price and skepticism in some quarters as to the adequacy of ore reserves. Because of the highly refractory nature of beryl, the extreme reactivity of the metal at elevated temperatures, and the number of process steps

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

required, metallic beryllium is produced with a low over-all efficiency.[2] However, increased consumption in those applications where it is superior to other alloys will do much to lower the price. The mineralogical occurrence of beryl in pegmatite dikes is extremely common, but it is always sporadic and in no instance has been found to have continuity like ores in a vein. The current output is handcobbed by low-paid labor or is recovered as a none-too-remunerative byproduct. The quantities of beryl obtained in this fashion have supplied the demand adequately to date, and the output can doubtless be expanded. Larger tonnages of beryllium may prove to be extractable economically from low-grade beryl ores amenable to flotation or possibly from other beryllium minerals rarer than beryl but less sporadic in individual deposits. Interest was aroused during 1941 in a helvite deposit discovered recently in New Mexico.[3]

Domestic production.—Mine shipments of beryl since 1937, when the Bureau of Mines began to collect data on this ore, are shown in the accompanying table. Shipments in 1941, 31 percent greater than in 1940, were the largest on record. Beryl is produced in several Western and New England States as a byproduct in the mining of feldspar, mica, and other pegmatite minerals. Pennington and Custer Counties in the Black Hills of South Dakota contributed 96 percent of the United States total in 1941, compared with 61 percent in 1940. Beryllium metal, alloys, and compounds are produced by the Beryllium Corporation of Pennsylvania, Temple (near Reading), Pa., and by the Brush Beryllium Co., Cleveland, Ohio. Beryllium oxide is produced by Clifton Products, Inc., Painesville, Ohio. A plant for the manufacture of beryllium oxide and carbonate was being erected during 1941 at Harbor City, Calif., by the Calloy Co.

Beryllium ore (beryl) shipped from mines in the United States, 1937–41

Year	Mine shipments			State
	Short tons	Value		
		Total	Average per ton	
1937	75	$1,640	$21.87	Colorado, Maine, South Dakota.
1938	25	770	30.80	Maine.
1939	95	2,720	28.63	Colorado, Maine, South Dakota.
1940	121	3,721	30.75	Do.
1941	158	7,300	46.20	Maine, New Hampshire, South Dakota, Wyoming.

Foreign trade.—Beryl imports into the United States have mounted steadily to 1,635 short tons in the first 9 months of 1941. Imports in recent years, by country of origin, are shown in the accompanying table. United States concessions in the reciprocal trade agreement with Argentina, effective November 15, 1941, included a reduction in the duty on beryllium oxide and carbonate from 25 percent ad valorem to 12½ percent, although the older duty may be restored on 6 months' notice any time after the end of the present war. No beryl is exported by the United States, but beryllium-copper master alloys have been shipped to Great Britain for several years.

[2] Stott, Louis L., The Present Status of Beryllium: Soc. Aeronautical Weight Eng., Paper 6, 1st Nat. Meeting, February 25, 1941 (revised April 24, 1941), p. 4.

[3] Strock, Lester W., A New Helvite Locality—A Possible Beryllium Deposit: Econ. Geol., vol. 36, No. 7, November 1941, pp. 748–751.

Beryl imported for consumption in the United States, 1937–41, by countries, in short tons

Country of origin	1937	1938	1939	1940	1941 (Jan.–Sept.)
Argentina	152	78	384	422	693
Brazil			75	377	942
India, British	30	58			
Union of South Africa		10		6	
Total:					
Short tons	182	146	459	805	1,635
Value	$8,031	$5,990	$14,574	$23,865	$77,680
Average per ton	$44.13	$41.03	$31.75	$29.65	$47.48

Price.—Domestic beryl, 10–12 percent BeO, was quoted nominally by the trade journals during 1941 at $30–$35 a short ton, f. o. b. mines, but actual prices obtained averaged over $45 a ton. Nominal quotations on imported beryl, c. i. f., by the American Metal Market were advanced on February 26 from $45–$49.50 to $47–$52 for 10–11 percent BeO and from $49.50–$54 to $52–$55 for 11–12 percent BeO, and the quotations remained at the new level throughout the remainder of 1941. The actual New York price on imported beryl containing 10–12 percent BeO is said to have been $50–$65 a ton during the early part of 1941 and $60–$72 in later months. Beryllium-copper, master alloy of 4 percent Be and remainder Cu, was priced unchanged at $15 per pound of contained Be, and metallic beryllium and beryllium-aluminum at $45 to $50 per pound of contained Be. Ceramic Industry quoted beryllium oxide, c. p., calcined at 1,350° C., at $4 a pound during 1941.

Beryllium-copper alloys.[4]—The outstanding use of beryllium today is in beryllium-copper alloys fabricated into springs, diaphragms, and motor parts subject to wear. These alloys generally contain about 2 percent beryllium and the remainder copper (although the beryllium content ranges from 0.1 to 3.5 percent), and 0.13 to 2.60 percent cobalt, chromium, or silver is often added. Beryllium hardens copper and increases its tensile properties without greatly decreasing electrical conductivity. Parts subject to wear in airplane engines are absorbing the largest quantities of beryllium-copper at present. In such applications as tappet roller bushings, counterweight bushings, oil pressure-relief-valve seats, and spacing shims, and, in general, in heavily loaded bushings where the action is eccentric or reciprocating and in parts mating with hard steel and subject to extreme vibration or shock loading, beryllium-copper is reportedly giving excellent service. Beryllium-copper springs have a large amplitude of movement combined with remarkable freedom from hysteresis or elastic drift—properties that enable them to possess and retain stable springiness to a much greater degree than springs made of any other available corrosion-resisting material. The dependability of these springs has prompted their use in sensitive altimeters, air-speed indicators, and a wide range of aircraft instruments, as well as in pressure gages, electrical contacts, business machines, camera shutters, telephone jacks, and radio equipment.

As beryllium-copper is nonmagnetic and has structural properties comparable to good alloy steels, it is used in parachute harness fasteners

[4] Stott, Louis L., Work cited in footnote 2. 10 pp. Beryllium—Its Present Field and Possible Future Applications. Steel, vol. 109, No. 17, October 27, 1941, pp. 62–64, 92–93.

and release springs to avoid magnetic disturbance of instruments. The alloy has a further advantage of nonsparking. Beryllium-copper hammers, wrenches, crowbars, chisels, and other tools are utilized in munition factories, petroleum refineries, and other plants where a spark from working steel against steel might ignite inflammable fumes or materials. Another interesting property of beryllium-nickel-copper alloys is illustrated by tests reported to indicate that the alloy is about 50 times more resistant to heat-checking than conventional nickel cast irons under frictional contact with materials used for brake blocks and clutch facings.

Other beryllium alloys.—Small additions of beryllium to nickel are said to impart physical properties even superior to those that can be obtained in the copper-base alloys. Interest in these alloys seems to have been centered in Europe, but small quantities of nickel containing 1.8 to 2 percent beryllium were produced in the United States during 1941. Beryllium-nickel has a very unusual combination of high tensile strength (270,000 p. s. i.) and elongation (8.8 percent in 2 inches). Applications to date include corrosion-resisting springs, springs subject to moderately high temperatures, hypodermic needles, and surgical instruments.

As beryllium has a low specific gravity (1.85), being only slightly heavier than magnesium (1.74) and 30 percent lighter than aluminum (2.70), it is being considered as a constituent of light metal alloys. Beryllium does not appear to alloy with magnesium, but industrial research on beryllium-aluminum is showing progress. Additions of 25–50 percent of beryllium greatly stiffen aluminum; and an alloy of this composition, called beralite, is being developed by Cooper-Wilford Beryllium, Ltd., Philadelphia, Pa. Beralite is said to be lighter than and as strong as duralumin, to have fatigue strength superior to that of any existing aircraft metals, and to have enough workability to be considered for aircraft forgings.[5] Suggested applications are in aircraft pistons, connecting rods, valve-actuating mechanisms, and certain air frames, such as control surfaces. Sawyer [6] compares beryllium-aluminum with standard aluminum-base aircraft alloys and states that, while higher modulus of elasticity greatly favors beryllium-aluminum alloys, this factor cannot overcome the disadvantage of inferior tensile strength where ductility is important. Addition of other components probably can improve low creep strength and other properties. The above statements, the author cited points out, concern properties at room temperature; at 600° F. (as may exist in a piston) beryllium-aluminum alloys have higher endurance limits and much higher tensile strength than the materials now in use and therefore hold out attractive possibilities if such parts can be made. A factor that has retarded development of beryllium-aluminum is the high price of metallic beryllium. Beryllium contained in aluminum alloy costs three times as much per pound as it does in copper or nickel, because it must be added to aluminum as pure metal, whereas it is introduced directly into copper and nickel as the less expensive oxide.

Beryllium has been used as a ferro-alloy in Germany, particularly, it is said, in armor plate and in a high-speed tool steel containing 12 percent Cr, 5 percent Ni, and 1 percent Be. Surface saturation of steel

[5] Wilford, E. Burke, Beryllium Alloys in Aviation: Aviation, vol. 41, No. 1, January 1942, pp. 92–93, 188.
[6] Sawyer, C. B., Beryllium as a Light Metal Component: Metals and Alloys, vol. 14, No. 1, July 1941, pp. 37–39.

by beryllium diffusion, a method somewhat analogous to sherardizing, greatly increases hardness. Additions of 1 to 2 percent of beryllium to various steels improve hardness, tensile strength, and acid resistance.

Beryllium metal and compounds.—Utilization of metallic beryllium has been limited principally to X-ray tubes, where small quantities of the metal are useful because of its transparency to X-rays. The second most important use of beryllium, quantitatively, is in white fluorescent lamps and fluorescent screens, where an oxide of high purity, containing less than 0.002 percent iron, is specified for the preparation of zinc-beryllium silicate. Beryllium oxide and beryllium carbonate, activated by uranium salts or rare earths, are utilized in luminescent paints. Pure beryllium oxide melts at 2,570° C.—550° C. higher than the melting point of alumina—and thus makes a good refractory. The washability of a new English textile made from seaweed is improved by treating it in a coagulating bath of beryllium acetate. Experiments indicate that beryllium carbonate may be a useful antirachitic substance.[7] It is reported that in recent years some 50 to 100 tons of raw beryl have been ground annually for use in ceramics.

Technologic developments.—Factors to be considered in exploring for peryl are outlined by Brinton.[8] In the course of its flotation investigations, the Bureau of Mines [9] found that a low-grade Nevada beryllium ore containing 1.3 percent BeO could be concentrated (using oleic acid as the collector reagent and Du Pont 23 as a frother) to material containing 5.5 percent BeO, representing 87 percent recovery of beryllium in 20 percent of the feed. When these flotation concentrates were dried and treated in a high-intensity magnetic separator, the nonmagnetic product contained 6.6 percent BeO in one-third the weight of the feed, but only half of the beryllium was recovered.

WORLD PRODUCTION

Production of beryl by various countries in recent years, insofar as data are available, is shown in the accompanying table.

World production of beryl, 1935–40, by countries, in metric tons [1]

Country [1]	1935	1936	1937	1938	1939	1940
Argentina	189	300	260	753	299	520
Australia, Western					6	2
Brazil (exports)		4		203	276	1,472
Canada (estimate)		18	18	9	161	(2)
India, British	126	89	24	15	8	(2)
Madagascar (estimated exports)	10	10	2	2	(2)	(2)
Portugal	2	2	21	(2)	(2)	(2)
Union of South Africa (estimate)	80	5	(2)	(2)	(2)	(2)
United States (mine shipments)	(2)	(2)	68	23	86	110

[1] In addition to countries listed, beryl may also be produced in France, Italy, Norway, Rumania, and U. S. S. R.
[2] Data not available.

Argentina.—Beryl is mined in the Provinces of Cordoba and San Luis. In previous years, the material has been exported only as raw beryl, but in 1941 a portion of the output was converted to beryllium

[7] Businco, L., (Rachitogenic Effect of Beryllium Carbonate): Rass. med. applicata lavoro, vol. 11, 1940, pp. 417–424; Ceram. Abs., vol. 20, No. 5, May 1941, p. 132.
[8] Brinton, Paul H. M.-P., Fundamentals in the Search for Beryllium: Min. Cong. Jour., vol. 27, No. 5, May 1941, pp. 20–21, 55.
[9] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 45. Ore-Testing Studies 1939–40: Bureau of Mines Rept. of Investigations 3564, 1941, pp. 26–28.

oxide-carbonate by the Sociedad Anonima Berilo Argentina in a new plant at Juan Ortiz, Province of Santa Fe.

Canada.—The property of Canadian Beryllium Mines & Alloys, Ltd., in Lyndoch Township, Ontario, was idle throughout 1941, but a shipment of ore to Kansas City, Mo., for testing a new reduction process was reported.[10] Mobirk Beryllium Mining Co., Ltd., did some development work on beryl deposits in the Winnipeg River district of Manitoba.

CALCIUM

Calcium metal formerly was imported from France and Germany, but in 1939 the Electro Metallurgical Co. built a plant at Sault Ste. Marie, Mich., and later expanded the capacity to several times the maximum imported in any 1 year. Domestic consumption of calcium metal during 1941 appears to have been about twice that in 1940.[11] Imports of calcium metal and calcium-silicon in recent years are shown in the accompanying table. During 1941 calcium metal, 97–98 percent, ton lots, was quoted by Charles Hardy, Inc., New York, at $1.25 a pound for carrots and about $2.00 a pound for castings, although the price was $1.50–$5.00 a pound in smaller lots. Calcium-silicon was quoted by Canadian Metals & Metallurgical Industries at 13½–15½ cents a pound, f. o. b. Welland, Ontario, during the first 5 months of 1941, 15–17 cents from June to September, and 15½–17½ cents during the last quarter of the year. In the United States, calcium-silicon was subjected to direct allocation by Office of Production Management General Preference Order M–20, effective July 29, 1941, which was revised and extended to May 31, 1942, by General Preference Order M–20–a, issued November 29, 1941. It was stated that production of calcium-silicon can be expanded as needed but that it requires very large quantities of electric power.

Calcium metal and calcium-silicon imported for consumption in the United States, 1937–41

Year	Calcium metal			Calcium-silicon		
	Pounds	Value		Pounds	Value	
		Total	Average per pound		Total	Average per pound
1937	23,767	$10,087	$0.42	3,751,918	$205,173	$0.055
1938	41,299	16,144	.39	1,402,314	77,003	.055
1939	41,718	17,758	.43	3,972,571	225,312	.057
1940	11,900	6,518	.55	2,131,758	154,424	.072
1941 (Jan.-Sept.)				111,994	8,377	.074

Metallic calcium is utilized as a scavenger in steel and secondary aluminum, to produce magnesium castings and calcium hydride, and to harden lead. Calcium is used as a deoxidizer and final addition in obtaining particularly clean steels and in imparting better working properties to high-nickel-chromium steels. Calcium-silicon (28–35 percent Ca and 60–65 percent Si) and calcium-manganese-silicon are likewise employed for this purpose, although the unalloyed metal may

[10] Northern Miner, vol. 27, No. 39, December 18, 1941, p. 2.
[11] Jeffries, Zay, Rare and Precious Metals: Min. and Met., vol. 23, No. 422, February 1942, p. 69.

have specific effects. Ready combination with oxygen and nitrogen may be among these effects, but the formation of a different type of sulfide and change of the nature of the nonmetallic inclusions when calcium is added as a metal are said to be the major reasons for its use.[12] Additions of calcium up to 0.25 percent in some magnesium castings reduce the heat-treating time by permitting higher temperatures and result in an improved surface. Calcium sometimes is used for deoxidizing aluminum castings and reconditioning scrap aluminum,[13] but Stroup [14] does not favor this procedure and states that the presence of calcium in aluminum alloys containing copper causes definite lowering of strength in the solution heat-treated temper. Metallic calcium is a starting point in the preparation of calcium hydride, which is a reducing agent in the production of titanium, uranium, vanadium, and zirconium. Calcium has been used to maintain lead in the emulsified state in high-lead-copper alloys, and calcium as a substitute for antimony in the hardening of lead is a promising application of strategic importance. Lead containing about 0.1 percent of calcium has properties equal to antimonial lead for cable sheathing, roofing sheets, and the negative plates, connector links, grid heads, and terminal posts of storage batteries. At present calcium-lead is prepared directly, either by electrolytic deposition of calcium in the lead or by dissociation of calcium carbide in lead, but production of this alloy from metallic calcium is said to be simpler and may be generally adopted in future.

COLUMBIUM AND TANTALUM

Domestic production of tantalum ore was resumed on a small scale in 1941. During the first 9 months of the year, columbium ore was imported at a considerably higher rate than during 1940, but entries of tantalum ore were lower. The Fansteel Metallurgical Corporation, North Chicago, Ill., a principal consumer of tantalite, was reported to have a 2-year supply of the ore at the end of 1941.[15] Mine shipments and imports in recent years are shown in the accompanying table. During the first 9 months of 1941, Nigeria supplied all the colum-

Tantalum ore shipped from mines and columbium and tantalum ores imported for consumption in the United States, 1937–41

Year	Mine shipments of tantalum ore		Imports			
			Columbium ore		Tantalum ore	
	Pounds	Value	Pounds	Value	Pounds	Value
1937	16,307	$13,317	922,654	$306,086	20,897	$40,742
1938	36,189	35,127	645,141	228,078	41,706	80,092
1939	340	200	109,132	37,062	56,561	82,990
1940			595,220	210,526	490,460	258,514
1941 [1]	250	[2] 280	983,495	348,087	276,968	126,282

[1] Import figures cover January to September, inclusive.
[2] Estimate.

[12] Kinzel, A. B., Calcium Metal Production, a New American Industry: Min. and Met., vol. 22, No. 418, October 1941, p. 490.
[13] Hardy, Charles, Calcium to Purify Scrap Aluminum: Metal Prog., vol. 40, No. 1, July 1941, p. 70.
[14] Stroup, Philip T., Calcium—Its Effect on Aluminum: Metal Prog., vol. 40, No. 6, December 1941, p. 903.
[15] Wall Street Journal, vol 118 No 153, December 30, 1941, p. 8

bium ore imported except about 5,000 pounds from Argentina and Brazil combined; of the imports of tantalum ore in the same period, 53 percent came from Belgian Congo, 35 percent from Brazil, and 12 percent from South Africa. Brazilian exports of tantalum ore during this period totaled 63 short tons, of which 59 percent was shipped to the United States.

Price.—Columbium ore is not quoted in the trade journals, but imports containing about 65 percent Cb_2O_5 have been valued at about 35 cents a pound in recent years. Tantalum ore (60-percent concentrates) has been listed by Metal and Mineral Markets at \$2.00–\$2.50 per pound of contained Ta_2O_5. Imported tantalum ore dropped in average value from \$1.47 a pound in 1939 to 53 cents in 1940 and 46 cents in 1941, probably owing to an increase in columbium content. Most of these ores are mixtures of columbite and tantalite, but the most desirable ores are high in one mineral and low in the other. Ferrocolumbium, 50–60 percent, was quoted throughout 1941 at \$2.25–\$2.35 per pound of contained Cb, f. o. b. Niagara Falls, N. Y. Columbium metal was quoted at \$227–\$254 a pound and tantalum metal at \$65–\$73 a pound.

Uses of columbium.—The addition of about 0.5 percent columbium to chrome steels improves weldability by inhibiting intergranular corrosion, reduces air-hardening, and increases oxidation resistance, creep strength, and impact strength, regardless of heat treatment. Aircraft exhaust stacks, manifolds, and collector rings are made of stainless steels containing about 0.8 percent columbium. Seybolt [16] found that 0.58 percent columbium brings the softening temperature of cold-rolled copper from 250° C. up to about 450° C. and that 0.29 percent brings the softening temperature of 80–20 cupronickel from 500° C. up to about 550° C. Iron containing 3 percent columbium is suitable for high-pressure steam turbines operating at temperatures exceeding 1,000° F. Columbium is a constituent of an aluminum alloy known as ceralumin,[17] which is said to be used quite widely in British aircraft. The addition of columbium to a chromium-aluminum-iron electrical resistance wire overcomes the detrimental effect of carbon on the life of elements built of such wires.[18]

Uses of tantalum.—Ultrahard cemented carbides of tantalum are being used increasingly—alone or in combination with carbides of tungsten or titanium—in wire-drawing dies, steel-cutting tools, and wear-resistant parts of machines. Large dies for cold-nosing artillery shells are among such uses. A cast alloy containing tantalum, columbium, and tungsten ("Tantung G"), which has a hardness approaching that of the hard carbides, plus much higher strength and toughness, is being used to increase production upon older machines not suited for employing cemented carbides. Tantalum metal has a variety of applications, of which perhaps the most important quantitatively is in the manufacture of corrosion-resistant equipment for chemical plants and laboratories. Tantalum metal is used in radio tubes, lamp filaments, neon tubes, electrolytic cathodes, surgical and dental instruments, heat interchangers, pump and valve parts, nozzles, spin-

[16] Seybolt, Alan U., Effect of Columbium on Some Annealing Characteristics of Copper and 80-20 Cupronickel: Am. Inst. Min. and Met. Eng. Tech. Pub. 1342, Metals Technol., vol. 8, No. 5, August 1941, 5 pp.
[17] Murphy, Alfred J., and Wells, Stanley A. E., Aluminum Alloys: U. S. Patents 2,214,431, 2,214,432, and 2,214,433, September 10, 1940: Chem. Abs., vol. 35, No. 3, February 10, 1941, p. 728.
[18] Swinden, Thomas (to Kemet Laboratories Co.), Electrical Resistances of Iron Alloys: U. S Patent 2,210,309, August 6, 1940: Chem. Abs., vol 35, No 1, January 10, 1941, p. 72.

nerets for synthetic textiles, temperature-control apparatus, electrical contacts, and lightning arresters for railway-signal circuits. Tantalum oxide is a component of a glass having a very high refractive index and low dispersion—factors that permit the manufacture of superior aerial camera lenses which are thinner and have less curvature. Sun and Silverman [19] studied glasses containing 5 to 36 percent tantalum oxide.

INDIUM

Augmented production of engine bearings and war-inspired restrictions on ordinary plating metals stimulated interest in indium during 1941. Indium is recovered as a byproduct of zinc and lead operations by the American Metal Co., Ltd., American Smelting & Refining Co., Anaconda Copper Mining Co., and National Zinc Co., Inc. Domestic production could be increased to more than 40,000 pounds annually, according to William S. Murray, president of the Indium Corporation of America.[20] In Mohave County, Ariz., the Indium Corporation of America has a property said to contain 35,000 tons of ore averaging about 2 ounces of indium per ton.[21] However, demand for the metal has not yet become sufficient to justify exploitation of this property, particularly in view of the ability of zinc refineries to supply ample quantities. Abroad, indium has been produced commercially in Germany, Belgium, and possibly Japan and U. S. S. R.

Price.—In December 1940 the price of metallic indium, as quoted in the trade journals, was reduced from $15 to $12.50 per troy ounce, where it remained throughout 1941.

Uses.—Indium is deposited on and alloyed with cadmium-nickel and copper-lead on bearings for airplane, automobile, and Diesel engines to resist the corrosive action of lubricants containing organic acids. After the nonferrous coating is applied to the ferrous base, an indium layer 0.001 to 0.0005 inch thick is plated on the undercoat and diffused through it at about 175°–180° C. to form a protective alloy surface containing 0.2 to 4 percent indium. Coatings of indium, alloyed with lead, copper, cadmium, zinc, silver, or gold, have been suggested for washers, contact points, light reflectors, molds for plastics, decorative metal strips, collapsible tubes, cosmetics containers, jewelry, and office machinery. Indium has been used to prevent corrosion by perspiration of the small pins in the hinges of spectacle frames. A steel article coated with a 4½-percent indium-lead alloy is reported to have successfully resisted severe exposure to salt spray. Indium-alloy coatings are easily polished and burnished.

In addition to plating, 0.5 to 5 percent indium is used in dental alloys, where it is said to impart superior compressive strength and resistance to tarnish. Indium is an advantageous constituent of certain low-melting alloys and has recently been found to improve the "wetting" properties of brazing materials through a wide range of melting points. The use of indium in pharmaceuticals and as a mordant for the dyestuffs industry is being developed.

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[19] Sun, Kuan-Han, and Silverman, Alexander, Tantalum Glass—K_2O-Ta_2O_5-SiO_2 Series: Jour. Am. Ceram. Soc., vol. 24, No. 5, May 1941, pp. 160–167.

[20] Jeffries, Zay, Work cited in footnote 11.

[21] Elder, Albert L., Textbook of Chemistry. Harper & Bros., New York, 1941, p. 662

RADIUM AND URANIUM

The Eldorado mine at Great Bear Lake, Northwest Territory, Canada, operated by Eldorado Gold Mines, Ltd., and the mine in Belgian Congo, operated by Union Minière du Haut Katanga, which together yield nearly the entire world output of radium-uranium ore, were both inoperative during 1941. The Canadian company, however, experienced in 1941 its best sales year to date, and its refinery at Port Hope, Ontario, is now operating on a 24-hour basis. Large ore stocks at the refinery are being cleaned up, and the mine at Great Bear Lake will resume production in 1942. Mining operations in Belgian Congo were halted as a result of the German invasion of Belgium in May 1940 and the consequent unavailability of refining facilities at Oolen, near Antwerp. In general, the United Nations are in a comparatively favorable position as regards radium and uranium. It is estimated that these countries possess two-thirds of the world radium supply and three-fourths of the uranium and, furthermore, control well over 95 percent of all the known ore reserves. Of the stocks held at Oolen, all of the radium and part of the uranium were removed from Belgium before the invasion and shipped to the United States. The Oolen refinery was not damaged, but the Germans apparently have not attempted to operate it on the basis of the small amounts of ore obtainable from St. Joachimsthal in Czechoslovakia and other European localities. The agreement between Union Minière du Haut Katanga of Belgium and Eldorado Gold Mines, Ltd., of Canada, dividing world markets for radium in a 60 : 40 ratio, was dissolved in 1941.

Domestic production.—Radium, uranium, and vanadium are recovered from carnotite ore mined in western Colorado and eastern Utah. The two radium producers in the United States are the Vitro Manufacturing Co., Pittsburgh, Pa., which had an output of 3 grams in 1941 and expects to supply 3 to 5 grams in 1942, and the S. W. Shattuck Chemical Co., Denver, Colo., which produced about 225 milligrams in 1941 and anticipates an output exceeding 1 gram in 1942.

Foreign trade.—Imports of radium salts, radioactive substitutes, and uranium ore and compounds are shown in the accompanying table. All of the imports during the first 9 months of 1941 were from Canada, except that 21 percent of the uranium compounds came from Belgian Congo.

Radium salts, radioactive substitutes, and uranium ore and compounds imported for consumption in the United States, 1937–41

Year	Radium salts			Radioactive substitutes (value)	Uranium ore		Uranium oxide and salts	
	Grams	Value						
		Total	Average per gram		Pounds	Value	Pounds	Value
1937	15 29	$377,659	$24,700	$711			203,473	$258,417
1938	38 75	787,025	20,300	5,746			376,708	520,540
1939	78.631	1,953,820	24,800	966	5	$10	1,439,324	1,197,786
1940	30.311	748,097	24,700	5,650	2,400,198	2,110,927	240,199	388,355
1941 (Jan.-Sept.)	4.063	101,480	25,000	13			229,872	345,264

Price.—In 1941 the market price of radium dropped from $30 a milligram to $25, and even lower. Individual sales at less than $20 a milligram were reported. Prices quoted at the end of 1941 by the Radium Chemical Co., Inc. (sales agent in America for Union Minière du Haut Katanga), were as follows: $23 a milligram for 1–99 milligrams, $21.50 for 100–499 milligrams, and $20 for 500 milligrams or over. Throughout 1941, Ceramic Industry listed uranium oxide at $1.75–$3.00 a pound; and Glass Industry quoted yellow or orange uranium oxide at $1.65 a pound, black uranium oxide at $2.55 a pound, and orange or yellow sodium uranate at $1.65 a pound.

Uses of radium.—The principal use of radium is in the treatment of cancer and skin diseases, but the war program is drawing on increasing amounts for luminous paints and industrial radiography. Clocks, gun sights, compasses, and various other types of instrument dials are coated with radium compounds to permit them to be seen under blackout conditions. Radium is used to detect flaws in castings, forgings, and welds of numerous kinds of metals and alloys. Aircraft parts hull castings, valves for power plants and refineries, cast piping, welded pressure vessels, gun carriages, turret tracks, shaft struts for ships, frogs for railroads, and turbine casings are among the equipment inspected in this way. From 25 to 1,000 milligrams of radium (usually 100 to 200 milligrams) in the form of radium sulfate in a duralumin container are ordinarily placed in the center of a circle of articles to be tested. X-ray films are fastened to the backs of the specimens, and the penetrating gamma rays cause a shadowgraph to appear upon the film very similar to one obtained with X-rays. Defects as small as 0.25 percent of the thickness of the article, ranging from ⅛ to 10 inches, can clearly be seen. Magnification of the images to 5 and 10 diameters reveals defects otherwise unnoticed. Radiographic inspection of magnesium-alloy castings was described in some detail by Bailey.[22] Some of the recent literature on industrial radiography has been summarized.[23] Progress in radiography prompted organization in October 1941 of the American Industrial Radium and X-ray Society, Inc. The primary aim of the society is to promote scientific education in industrial radiography; headquarters will be in Chicago.[24] A new use of radium is as a radium-beryllium salt in geophysical exploration for petroleum.

Figures showing radium transactions are not available, but preparations tested each year by the National Bureau of Standards, under the supervision of Dr. L. F. Curtiss, give some idea of movements. Such preparations included 9.0 grams of radium in 1937, 10.5 in 1938, 22.0 in 1939, 16.8 in 1940, and 19.9 in 1941.

Radon, polonium, and mesothorium.—Useful radiation from radium is not due to the radium itself but rather to its disintegration products. Radium first decomposes into the gaseous element radon (atomic number, 86). Radon is put in tubes and used in both hospitals and industrial plants. It loses its effectiveness after a few days, but in some circumstances this short life is advantageous. Radiologists in Great Britain were temporarily forced by German bombers to abandon most of their clinical work with radium because of the danger of losing

[22] Bailey, P. M., Radiography—Applied to Magnesium Alloy Castings: Metal Ind., vol. 59, No. 15, October 10, 1941, pp. 232–235.
[23] American Society for Testing Materials, Review of the Literature of 1939 on the Testing of Materials by Radiographic Methods: Bull. 111, August 1941, pp. 31–32.
[24] Steel, Industrial Radium, X-ray Society Formed: Vol. 109, No. 18, November 3, 1941, p. 59.

it. In its place, hospitals were supplied with radon, individual losses of which would not be significant. The radon tubes were filled in subterranean plants, one of which was financed with $25,000 cabled to London by the British War Relief Society in the United States.[25] Polonium is a radioactive element (atomic number, 84) recovered at the Port Hope refinery and used in minute traces in spark-plug electrodes to ionize the air gap and speed the passage of a hot spark under all temperature conditions, even when the battery is low. Made by the Firestone Tire & Rubber Co., the nickel electrodes either are coated with a film of polonium or contain 0.000000001 percent polonium as an alloy. The longer the radioactive spark plug is used, the more efficient it becomes.[26] Mesothorium is a radium isotope (atomic numbers, 88 and 89) which is used as a substitute for radium. It is obtained from monazite-sand residues and is more radioactive than radium itself. The principal application at present is probably in black-out paints. The number of mesothorium specimens tested annually by the National Bureau of Standards gives some index as to demand. Such specimens contained 1,026 milligrams in 1934, 300–600 yearly in 1935–38, 49 in 1939, and 301 in 1940 and reached a high of 1,451 in 1941.

Uses of uranium.—Uranium is now used principally in ceramics, luminescent paints, tool steels, and chemicals. Uranium oxides color pottery glazes and porcelain bodies black, gray, brown, or green in a reducing environment and yellow, orange, or red under oxidizing conditions. They are sometimes used as a crystallizing agent in crystalline glazes. Sodium uranate and sodium uranyl carbonate produce the fluorescence typical of uranium glasses, which are yellowish green in transmitted light and emerald green in reflected light. These compounds under other conditions color glass yellow, orange, or red.[27] Uranium salts are incorporated in luminescent paints, either for their own inherent fluorescence or as an activator for such accessory compounds as zinc-cadmium sulfide and beryllium oxide. Uranium imparts desirable properties to tool steels. The metal is introduced as ferrouranium or, more recently, as a master alloy containing 66 percent uranium and 33 percent nickel. Stainless silverware can be made by plating the ware in an electrolytic bath containing silver fluoride and compounds of uranium and tin. Uranium oxides are used as catalysts in a number of organic chemical reactions.

SELENIUM AND TELLURIUM

Production of selenium and of tellurium in the United States in 1941 increased 89 and 162 percent, respectively, and sales showed corresponding gains. Producers' stocks of both metals declined during the year. Selenium imports (all from Canada) expanded. Salient statistics for 1937–41 are shown in the accompanying table. Canada increased its production of selenium and tellurium during 1941, and the Germans are said to have brought into operation a new selenium plant in the Mansfeld copper district.[28] The base price of selenium (black, powdered, 99.5 percent) and of tellurium continued to be

[25] American Medical Association, Radon Production Plant given to England: Jour., vol. 116, No. 1, January 4, 1941, p. 58.
[26] American Chemical Society, News Edition: Vol. 19, No. 19, October 10, 1941, p. 1111.
[27] Ceramic Industry, vol. 38, No. 1, January 1942, pp. 107 and 112.
[28] Metal Bulletin (London), No. 2642, November 11, 1941, p. 4.

$1.75 a pound throughout 1941. Glass Industry quoted barium selenite at $1.40–$1.60 and sodium selenite at $1.50–$1.65 a pound.

Salient statistics of selenium and tellurium in the United States, 1937–41

Year	Selenium					Tellurium		
	Production (pounds)	Sales [1] (pounds)	Producers' stocks at end of year (pounds)	Imports [2]		Production (pounds)	Sales [1] (pounds)	Producers' stocks at end of year (pounds)
				Pounds	Value			
1937	435,821	282,598	306,200	92,523	$161,382	51,409	23,365	93,200
1938	225,674	166,494	365,[illegible]00	101,084	163,598	11,076	26,944	77,300
1939	227,131	345,726	246,800	124,830	193,168	25,234	63,431	39,100
1940	328,731	368,709	206,800	134,429	198,163	85,622	88,996	35,700
1941	620,493	681,650	146,000	[3] 139,505	[3] 204,608	224,639	239,983	20,400

[1] Bureau of Mines not at liberty to publish value.
[2] Includes selenium salts.
[3] Figures cover January to September, inclusive.

Selenium, in conjunction with cadmium, is important as a red colorant in ruby glasses for signal lenses, tail lights, fire globes, and tableware. Antithetically, selenium acts as a decolorizer; 0.8 ounce per ton of glass imparts a pink that cancels the green from iron impurities and thereby yields a virtually colorless product. Increasing quantities of selenium are used in rectifiers and light-sensitive cells and for flameproofing wire and cable insulation. Additions of selenium or tellurium have been found to increase the ductility of nickel-manganese steels and to improve machinability of stainless steels and copper alloys. Augmented demand for tellurium is principally as a carbon stabilizer in cast iron. Tellurium is also called upon to toughen lead [29] and rubber. Tellurium-lead work-hardens and is resistant to acids, even at high temperatures.

TITANIUM

Soon the United States will attain self-sufficiency in another mineral—ilmenite—through development of the Adirondack titaniferous magnetite deposits, which was begun in 1941. The project was born of the necessity to discontinue the practice of importing several hundred thousand tons of ilmenite annually from India. Such cargo space was needed for the transportation of other ores more directly essential to the victory program. Rutile from Australia faced a somewhat more fortunate situation, for ships delivering war supplies in the South Pacific loaded ores for the return voyage. Titanium pigments were in great demand during 1941. The Navy is said to have purchased about 2,500 tons in that year, and individual orders of 300 tons for aircraft camouflage lacquer and 350 tons to paint the interior of a single airplane plant were reported.[30] Such military requirements prevented the paint industry from obtaining much more than 60 percent of its needs for civilian consumption and forced manufacturers to use less titanium dioxide and more white lead.[31] Titanium pig-

[29] Hofmann, Wilhelm, and Hanemann, Heinrich, Work Hardening and Precipitation Hardening of Lead-Tellurium Alloys: Ztschr. Metallkunde, vol. 33, February 1941, pp. 62–68; Metals and Alloys, vol. 14, No. 1, July 1941, pp. 110, 112.
[30] Corddry, G. W., Titanium and the Present-Day Situation: Paint Ind. Mag., vol. 56, No. 11, November 1941, pp. 370–372.
[31] Business Week, No. 637, November 15, 1941, pp. 42, 44–45.

ments were put under allocation by Office of Production Management General Preference Order M–44, effective December 1, 1941. Subsequent amendments moved the effective date to January 1, 1942, clarified the original text, and increased from 20 percent to 25 percent (effective February 1, 1942) the proportion of titanium pigments that had to be set aside by producers for direct allocation by the War Production Board. No price action on titanium pigments was taken during 1941, but to stem a proposed advance the Office of Price Administration, on January 2, 1942, requested the stabilization of prices at levels of October 1, 1941, and 2 months later made the informal request mandatory by issuing Price Schedule 98, effective March 1, 1942.

Domestic production.—Ilmenite and rutile were produced in Arkansas, Florida, and Virginia during 1941, mining of ilmenite in North Carolina was begun early in 1942, and plans were made to work titanium ore near Elma, Wash. The Bureau of Mines is not at liberty to publish figures showing domestic production of titanium ores. Ilmenite concentrates shipped from domestic mines in 1941 contained 42 to 54 percent TiO_2, and rutile concentrates contained 92 to 95 percent TiO_2. The geology of the Virginia titanium deposits was described in some detail by Ross.[32] The most significant feature of the 1941 titanium picture was the plan to exploit the Adirondack titaniferous iron ores. Mining will be begun in the summer of 1942, and at full capacity the project will enable the United States to be virtually self-sufficient in supplies of ilmenite. The property is being developed by the Titanium Division, National Lead Co., and the following details are abstracted from a comprehensive report by I. D. Hagar,[33] general manager.

In the Adirondack Mountains at Newcomb, Essex County, northeastern New York, a titaniferous iron-ore deposit, known as the MacIntyre Development, is being opened up by the National Lead Co. to obtain titanium for use in pigments. Purchased were some 7,000 acres, including the Sanford Hill deposit, located on the east shore of Lake Sanford, and the Iron Mountain deposit, about 1½ miles to the northeast. The National Lead Co. offered through the Office of Production Management to make a part of the output available to any pigment producer who would finance the requisite additional facilities. In this manner the Krebs Pigment & Chemical Division of E. I. du Pont de Nemours & Co., Inc., acquired an interest in the development and will receive one-fourth of the production for 10 years. The program of operation calls for a daily mine output of 5,500 long tons of ore analyzing 16 percent TiO_2, from which the mill will produce 800 long tons of ilmenite concentrates containing about 48 percent TiO_2. In addition, there will be a byproduct of approximately 1,800 tons daily of low-phosphorus magnetite. There is some question as to the ready marketability of this concentrate, since it will contain about 10 percent TiO_2, the effects of which in a blast furnace constitute a controversial question. However, much interest is being expressed by various steel manufacturers in the possibility of utilizing this magnetite, in spite of the alleged handicap. Beginning in May 1941, a core-drilling program involved the extraction of over 11,000 feet of diamond-drill cores from 70 drill holes. Examination of these cores showed that there is available in the Sanford Hill deposit above lake level approximately 15,000,000 tons of ore analyzing 16 percent TiO_2. This quantity is estimated to constitute a sufficient supply for the domestic pigment industry for at least 10 years.

The mine will be of the open-pit or bench-type, utilizing churn drills and electrically operated shovels to load the broken ore on heavy-duty mine trucks for haulage to the mill. The mill will contain the following units: (1) The crushing plant, equipped with a 48- by 60-inch jaw crusher, a 5½-foot standard cone

[32] Ross, Clarence S., Occurrence and Origin of the Titanium Deposits of Nelson and Amherst Counties, Va.: Geol. Survey Prof. Paper 198, 1941, 59 pp.

[33] Hagar, I. D., Titanium and the MacIntyre Development: Paint Ind. Mag., vol. 61, No. 12, December 1941, pp. 410–418.

See also, Oliver, Frank J., Titaniferous Adirondack Ores Being Reworked: Iron Age, vol. 149, No. 10, March 5, 1942, pp. 53–59.

crusher, a 5½-foot shorthead cone crusher, and attendant screens and conveyors. (2) The wet mill, which will contain the crushed-ore bins, 4 rod mills with attendant elevators, screens, and pumps, 12 Crockett wet-belt separators for separating the magnetite, 96 wet-concentration tables for separation of the ilmenite, and units for dewatering the concentrates. (3) The dry mill, in which is included a battery of steam coil driers, operated by two 500-hp. boilers, and 21 Wetherill dry magnetic separators. Cost of development is estimated at $7,750,000. Materials for the entire development were made available through the issuance by the Office of Production Management of a blanket A-1-c Preference Rating Certificate, one of the highest blanket priorities granted so far to a commercial enterprise not directly engaged in the manufacture of weapons.

Foreign trade.—Imports of titanium ore and ferrotitanium in recent years are shown in the accompanying table. Of the 139,944 long tons of ilmenite imported during the first 9 months of 1941, 95 percent came from British India, 3 percent from Canada, and 1 percent each from Brazil and Portugal. Imports of rutile during the same period, including the rutile in zircon-rutile concentrates from Australia, are estimated at 4,000 short tons—78 percent from Australia and 22 percent from Brazil. Exports of titanium pigments from the United States were 5,950 short tons during the first 9 months of 1941 and 3,592 in the corresponding period of 1940. Such exports totaled 4,962 tons in the 12 months of 1940 compared with 4,319 in 1939.

Titanium ore [1] and ferrotitanium imported for consumption in the United States, 1937–41

Year	Titanium ore				Ferrotitanium	
	Ilmenite		Rutile [1]			
	Long tons	Value	Short tons	Value	Pounds	Value
1937	153,993	$770,757	665	$67,643	4,500	$608
1938	209,174	1,018,403	230	26,533		
1939	255,872	1,126,200	442	23,170	350	77
1940	197,894	750,590	156	14,849		
1941 (Jan.-Sept.)	139,944	574,651	[1] 930	[1] 110,002		

[1] Excludes rutile in zircon-rutile concentrates from Australia, such imports are estimated at approximately 3,000 tons from January to September 1941

Prices.—Quotations for ilmenite, 50–60 percent TiO_2, at $18–$20 a long ton were replaced in February by prices of $28–$30 for straight 60-percent material, which held throughout 1941, according to Metal and Mineral Markets. Rutile, 88–90 percent TiO_2, advanced $10 in April to $95 a short ton, and 94-percent concentrates remained at 8–10 cents a pound during all of 1941. Titanium metal, 96–98 percent, was listed at $5–$5.50 a pound. Throughout 1941, Steel quoted ferrotitanum at $1.23 per pound of contained Ti for 40- to 45-percent grade and $1.35 for 20- to 25-percent grade, and ferrocarbontitanium, 15–20 percent Ti, at $142.50 a short ton for 6- to 8-percent carbon and $157.50 for 3- to 5-percent carbon. The base price of titanium dioxide was 13½–15½ cents a pound during the first half of 1941, according to Oil, Paint and Drug Reporter, but at the beginning of July was raised to 14½–16½ cents, at which level it was fixed by Price Schedule 98, previously noted.

Uses.—Most of the titanium supply is consumed as dioxide in paints, paper, rubber, leather, ceramics, plastics, linoleum, printing ink, textiles, cosmetics, soap, and welding-rod coatings; the remainder

goes into titanium ferro-alloys, hard-cutting alloys, other nonferrous alloys, and metallic titanium. Domestic production of titanium pigments has more than doubled since 1938 and, according to Chemical and Metallurgical Engineering, approached 165,000 short tons in 1939. Titanium white paints are noted for a high degree of opacity, reflectance, and durability. Titanium dioxide makes it possible to manufacture workable porcelain enamels with a higher degree of acid resistance than can be obtained by any other means; at the same time, a remarkable degree of opacity in developed and gloss is improved.[34] Ilmenite is the source of all titanium pigments and also enters into the production of alloys and welding rods. By far the largest use of rutile is as a flux in welding-rod coatings, where its function is to shield the arc from oxidation during welding and to produce a brittle slag, which protects the cooling weld deposit.[35] The second most important use of rutile is in steel manufacture, where ferrotitanium and ferrocarbontitanium act as strong deoxidizers (to some extent replacing aluminum) and as addition agents to inhibit intergranular corrosion of stainless steels and air-hardening of 5-percent chromium steels.[36] A new type of permanent magnet contains 6 to 12 percent titanium.[37] Rutile is also used in ceramics and a number of nonferrous alloys, particularly titanium-aluminum, which improves the grain of aluminum castings. Titanium carbide is a constituent of hard alloys used in machine tools. A comprehensive Russian technical article on this application has recently been translated.[38] The use of metallic titanium has been limited principally to radio tubes. Titanium deserves study as a structural material, although it is difficult to produce metal free from objectionable oxygen and nitrogen.[39] Traces of metallic titanium in mercury boilers inhibit corrosion and facilitate heat transfer. Titanium tetrachloride is utilized in smoke screens and in purifying aluminum alloys.

WORLD PRODUCTION

Australia.—Zircon Rutile, Ltd., Byron Bay, New South Wales, increased its production of zircon-rutile concentrates in 1941.[40] The International Titanium Corporation, controlled by the American Rutile Corporation and Ventures, Ltd., of Canada, began producing concentrates of rutile and zircon in New South Wales in June 1941 and shipping the material to Carteret, N. J., for further separation.[41] Titanium minerals and zircon are also being recovered from black sands at Lower Piper River near Low Head, on the northern coast of Tasmania.[42]

Brazil.—During the first 9 months of 1941, Brazil exported 2,621 metric tons of ilmenite and 1,462 metric tons of rutile. All the ilmenite and 57 percent of the rutile were shipped to the United States.

[34] Tinsley, S. G., Titanium Oxide as an Ingredient of Porcelain Enamel Frits: Ceram. Ind., vol. 38, No. 3, March 1942, pp. 36-39.

[35] Johnston, J. Murray, Rutile and Zircon: Am. Inst Min. and Met. Eng., Ann. Meeting, New York, N. Y., February 11, 1942, 3 pp

[36] Steel, Modern Contributions of Titanium to Steel Production: Vol. 109, No. 18, November 3, 1941, pp 96, 110-111

[37] Howe, Goodwin H. (to General Electric Co.), Alloys for Permanent Magnets: U. S. Patent 2,264,038, November 25, 1941; Chem. Abs., vol. 36, No 6, March 20, 1942, p. 1585.

[38] Meerson, G. A., and Lipkes, Ya. M. (Hard Metal Alloys, Tungsten Carbide—Titanium Carbide—Cobalt Mixtures): Zhurnal Prikladnoy Khimii, No. 12, 1939, p. 1759 ff. Trans. by W. D. Jones, Metal Ind., vol. 59, No 19, November 7, 1941, pp. 290-293, No. 20, November 14, 1941, pp. 306-308.

[39] Dean, R. S., Progress Reports—Metallurgical Division. 50. Annual Report of the Metallurgical Division, Fiscal Year 1941: Bureau of Mines Rept. of Investigations 3600, 1941, pp. 52-53.

[40] Industrial Australian and Mining Standard, vol 96, No. 2478, September 15, 1941, p. 211; vol. 96, No. 2479, October 1, 1941, p. 225.

[41] Northern Miner, vol. 27, No. 45, Jan. 29, 1942, p. 9.

[42] Mining Journal (London), vol. 214, No. 5535, September 20, 1941, p. 428.

World production of titanium concentrates (ilmenite and rutile), 1936–40, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1936	1937	1938	1939	1940
Ilmenite:					
Australia:					
New South Wales		670	460	(1)	(1)
South Australia		8	2	2	(1)
Brazil (exports)	9	234	317	10	12
Canada (shipments)	2,328	3,836	188	3,351	(1)
Egypt	24	317	90	(1)	(1)
Federated Malay States (exports)	10,376	6,290	6,462	11,098	2,596
India, British	141,327	182,142	256,268	(1)	(1)
Norway	67,194	84,209	62,724	55,027	(1)
Portugal	183	1,456	568	409	399
Senegal	[2] 3,227	3,075	8,436	(1)	(1)
United States	(3)	(3)	(3)	(3)	(3)
Rutile:					
Australia: New South Wales	(1)	[4] 1,195	(1)	(1)	(1)
Brazil (exports)	768	377	488	489	499
Cameroun (French)	55	103	118	(1)	(1)
Norway	198	187	124	166	(1)
South-West Africa	54	16			
United States	(3)	(3)	(3)	(3)	(3)

[1] Data not available.
[2] Exports.
[3] Bureau of Mines not at liberty to publish figures.
[4] Includes 72 tons of mixed rutile-ilmenite concentrates.

Canada.—Ilmenite production from St. Urbain, Quebec, increased in 1941. Other titaniferous iron deposits were being investigated and may contribute to the 1942 output.[43] Titanium pigment imports by Canada in 1940 totaled 3,069 short tons, principally from the United States.[44]

Norway.—Titanium deposits were reported discovered in Norway as a result of a systematic survey conducted by Norwegian and German geologists and engineers.[45]

ZIRCONIUM

Zircon is recovered from beach sands near Melbourne, Fla., by the Riz Mineral Co. as an accessory of titanium ore and from gravels near Lincoln, Calif., by the Fay Placers Mining Co. as a byproduct of gold dredging. Although domestic production reached 3,646 short tons in 1927, there was none from 1929 to 1939. The rate of output was small during 1940 and 1941 but was increased somewhat early in 1942. Some work was done on a zircon deposit in Wisconsin during 1941. Imports of zirconium ore and zirconium ferro-alloys in recent years are shown in the accompanying table. Entries of zirconium ore during the first 9 months of 1941 totaled 20,101 short tons—73 percent from Australia, 24 percent from Brazil, and 3 percent from British India. Some comments on the Australian properties may be found in the foregoing titanium discussion in this chapter. The Brazilian zirconium ore is essentially baddeleyite and has a ZrO_2 content (82 percent) approximately 1½ times that of Australian zircon. Melzer and Chambers [46] have described the deposits in Brazil.

[43] De Mille, John B., Mining in Quebec During 1941· Canadian Min. Jour., vol. 63, No. 2, February 1942, p. 85.
[44] Foreign Commerce Weekly, vol. 6, No. 7, February 14, 1942, p. 23.
[45] Chemical and Metallurgical Engineering, German Aid Stimulates Establishment of New Plants for Producing Synthetics in Europe: Vol. 48, No. 12, December 1941, p 116.
[46] Melzer, W., and Chambers, G. H., Zirconia in Brazil: Foote-Prints, vol 14, No. 1, June 1941, pp. 17-21, 24-26.

Zirconium ore [1] *and zirconium ferro-alloys imported for consumption in the United States, 1937–41*

Year	Zirconium ore [1]		Zirconium ferro-alloys	
	Short tons	Value	Pounds	Value
1937	8,934	$129,576	230,449	$18,085
1938	2,093	62,138	244,126	13,520
1939	3,433	49,919	799,269	50,169
1940	16,845	252,749	533,055	37,126
1941 (Jan.–Sept.)	20,101	446,286		

[1] Includes zircon-rutile concentrates from Australia.

Price.—Throughout 1941, Metal and Mineral Markets quoted, unchanged from 1940, zirconium ore, 55 percent ZrO_2, at $60–$70 a short ton, f. o. b. Atlantic seaboard; zirconium ferrosilicon at $102.50–$107.50 a long ton for 12–15 percent Zr content and 14–16 cents a pound for 35–40 percent Zr; and powdered zirconium metal at $7 a pound. Ceramic Industry quoted crude zircon, pound basis, at 5–7 cents, refined zircon at 8–10½ cents, and zirconium oxide at 40–49 cents.

Uses.—The bulk of the zirconium is consumed in ceramics, chiefly in porcelain enamels and pottery glazes but also in electrical and chemical porcelains and heat-resistant glasses. The function of zirconium in enamels and glazes is opacification,[47] and this use conserves significant amounts of antimony, tin, and zinc. The second-largest use of zirconium is in refractories, particularly for glass-melting furnaces. Zirconium purifies, hardens, and strengthens steels and acts with aluminum to harden cupronickel. Metallic zirconium as powder or ductile metal is used in photoflash bulbs, radio tubes, ammunition primers, and welding rods. Zirconium compounds are important in tanning, and zircon sand is an advantageous foundry sand.

[47] King, Burnham W., Jr., and Andrews, A. I., Development of Opacity in Zirconia Enamels: Jour. Am. Ceram. Soc., vol. 24, No. 11, November 1941, pp. 360–367. Solubility of Zirconia in Soda-Borosilicate Glasses: Pp. 367–371.
Commons, C. H., Jr., Effect of Zircopax Additions on Abrasion Resistance and Various Properties of Several Glazes: Jour. Am. Ceram. Soc., vol. 24, No. 5, May 1941, pp. 145–147.
Ceramic Industry, vol. 37, No. 5, November 1941, p. 38.

PART III. NONMETALS

BITUMINOUS COAL AND LIGNITE [1]

SUMMARY OUTLINE

SURVEY OF THE BITUMINOUS-COAL AND LIGNITE INDUSTRY IN 1941

Under the stimulus of increased industrial activity arising from the national defense program, coal requirements increased sharply in 1941, and production was the largest since 1929. During the first quarter production was high to fill orders by consumers for storage in anticipation of possible suspension of mining when the wage contract expired on March 31. Output was largely at a standstill during April pending the signing of a new wage contract.

Production.—The estimated output of soft coal in 1941 was 511,-290,000 net tons, an 11-percent increase over 1940. Following the trend of industrial activity, the production for 1941 was 65 percent above the record low of 1932 and only 4 percent below the 534,989,000 tons of 1929 (see figs. 1 to 3 and tables 2 and 3). The trend of average value is shown in table 18.

Consumption.—Each of the major classes of consumers used more coal in 1941 than in 1940, and the increase ranged from 119 percent for beehive coke ovens to 8 percent for byproduct coke ovens (see table 4).

[1] Data for 1941 are preliminary; detailed statistics with final revisions will be released later. Data for 1939 and 1940 are final.

The collection of statistics on the bituminous-coal industry which before 1937 was conducted by the Bureau of Mines is now performed by the Bituminous Coal Division, U. S. Department of the Interior, Dan H. Wheeler, Director.

Material in this chapter was prepared in the Division's Economics Branch under the supervision of G. A. Lamb, chief. It was completed under the immediate direction of W. H. Young, in collaboration with R. L. Anderson, M. E. McMillan, and R. M. McKinney. The figures for 1939 were compiled under a joint agreement between the Bureau of the Census and the Bituminous Coal Division.

Changes in stocks.—The reserve supply of coal in the hands of industrial consumers and in retail coalyards rose from a total of 50,998,000 net tons at the beginning of the year to 62,737,000 tons at the close. In spite of the increase in total tonnage, the days' supply of stocks advanced only from 38 to 40 because of the increased rate of consumption. Between the same periods, stocks on the upper Lake docks advanced 779,188 tons, whereas unbilled coal in cars at the mines or classification yards fell 378,600 tons (see fig. 1 and tables 1 and 5).

Mechanization.—Sales of mechanical loading equipment for use in bituminous coal mines, in terms of total capacity, increased 31 percent in 1941 over 1940.

Mechanical cleaning.—Sales of mechanical cleaning equipment during 1941 indicate a gain over earlier years in mechanically cleaned coal. The total capacity of cleaning plants sold in 1941 is estimated

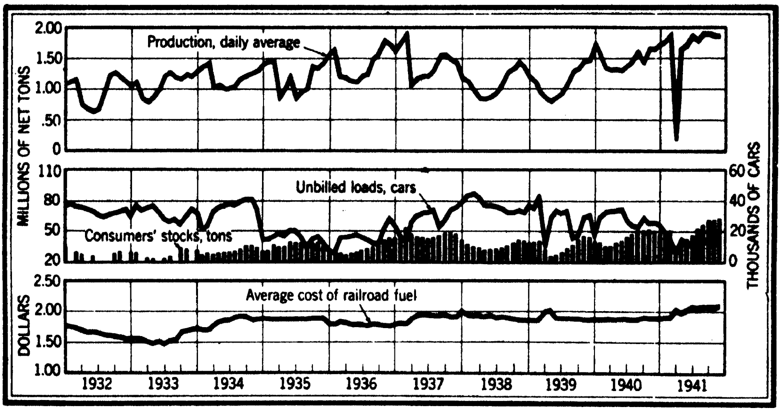

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal and lignite in the United States, 1932–41.

at 8,000 net tons of cleaned coal an hour (see Coal Age, February 1942, p. 66).

Trend of employment.—Estimates of the average number of men employed at bituminous coal and lignite mines in 1941 indicate a rise over the 1940 figure, which was 439,000. Indexes compiled by the Bureau of Labor Statistics upon the basis of a sample that includes more than half the workers in the industry show an increase of almost 4 percent in employment for 1941 over 1940 if normal operations during the April suspension are assumed in 1941. Reports from mining departments of several States also indicate a similar increase for the same period. These data suggest an estimate of 459,000 employees for 1941.

Trend of capacity.—The potential output upon a 308-day basis was 703,000,000 tons in 1940. Under the 5-day week, full-time operation is limited to approximately 261 days. The potential output of mines operating upon a 261-day basis was 595,000,000 net tons in 1940 compared with the total actual production of 460,771,500 tons.

Trend of fuel efficiency.—The upward trend in the efficient utilization of fuel in 1941 made some slight inroads into the coal market (see fig. 4 and table 6).

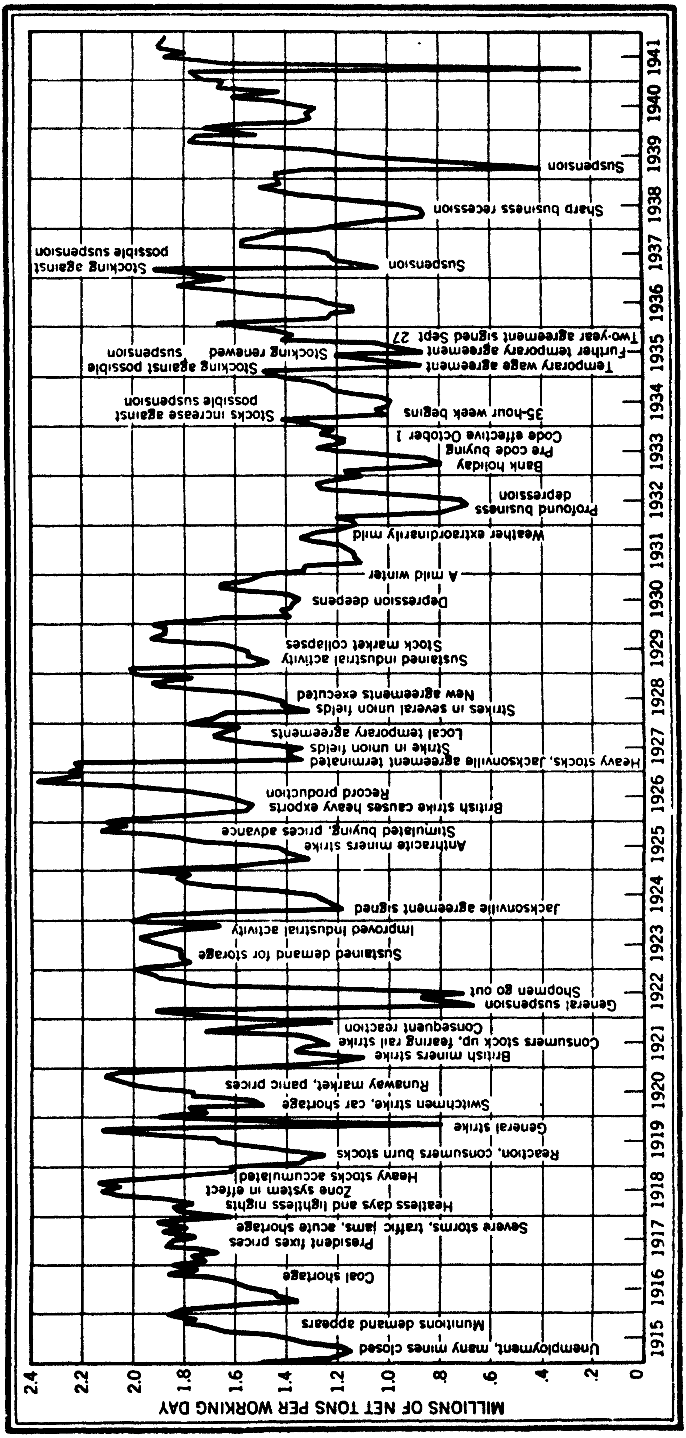

FIGURE 2.—Average production of bituminous coal and lignite in the United States per working day in each month, 1915–41.

Competition of oil and gas.—The competitive struggle of coal with oil and gas continued in 1941. The consumption of coal by railroads in 1941 increased 15 percent over 1940, but the consumption of oil by railroads increased 21 percent during the same period. Electric public utilities consumed 21 percent more coal and 21 percent more oil in 1941 than in 1940. The kilowatt-hours produced by water power at electric public utility power plants increased 7 percent in 1941 over 1940. (See figs. 5 to 7 and tables 7 to 9.)

In domestic heating comparable figures are available for mechanical firing equipment only. Sales of domestic stokers using bituminous

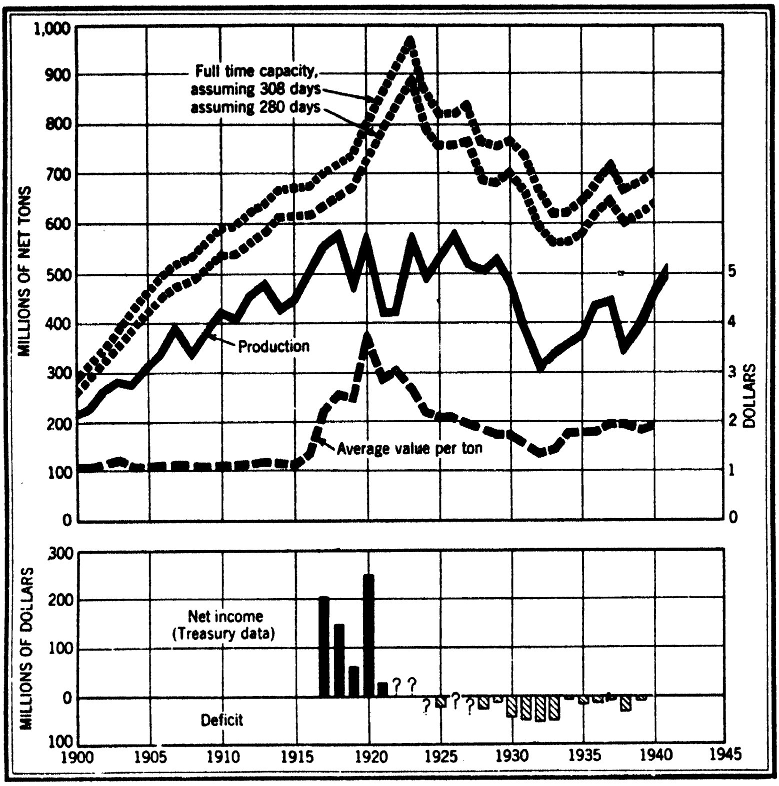

FIGURE 3.—Trends of bituminous coal and lignite production, realization, mine capacity, and net income or deficit in the United States, 1900–1941.

coal rose from 123,167 in 1940 to 158,734 in 1941, or 29 percent, whereas shipments of domestic oil burners and boiler-burner and furnace-burner units rose from 245,799 to 271,673, or 10 percent.

SOURCES OF DATA AND ACKNOWLEDGMENTS

Bituminous coal and lignite production statistics for 1941 are preliminary estimates prepared by the Bituminous Coal Division in accordance with standard procedure used in the past.

The 1939 statistics on bituminous coal and lignite were obtained through a survey conducted jointly by the United States Depart-

ment of Commerce, Bureau of the Census, and the United States Department of the Interior, Bituminous Coal Division.

The 1940 bituminous coal statistics were compiled by the Bituminous Coal Division and the 1940 lignite statistics by the Bureau of Mines.

Final production of bituminous coal and lignite for 1940 was 460,771,500 net tons. This differs slightly from 461,318,629 tons, as published in January 1942 in Mineral Industry Surveys HSS 297 by the Bureau of Mines. These two figures differ largely because the annual canvass of the Bituminous Coal Division includes only mines with 1,000 tons or more yearly production, whereas the canvass of the Bureau of Mines is concerned with the production of all mines in which men are employed and hence are exposed to accident hazards incident to mining.

SALIENT STATISTICS

TABLE 1.—*Salient statistics of the bituminous coal and lignite industry in the United States, 1939–41*

[All tonnage figures represent net tons]

	1939	1940	1941
Production	394,855,325	460,771,500	[1] 511,290,000
Exports to Canada and Mexico [2]	9,975,919	13,537,342	(3)
Exports overseas and all other [2]	1,614,559	2,928,586	(3)
Imports [2]	355,115	371,571	(3)
Consumption in the United States (calculated) [4]	379,768,962	438,250,143	(3)
Stocks at end of year:			
Industrial consumers and retail yards	44,571,000	50,998,000	62,737,000
Stocks on upper Lake docks	7,590,254	6,998,258	7,777,446
Unbilled loads, at mines or in classification yards [5]	1,553,100	1,298,300	919,700
Price indicators (average per net ton):			
Average cost of railroad fuel purchased, f. o. b. mines [6]	$1.91	$1.88	$2.02
Average cost of coking coal at merchant byproduct ovens [7]	$4.57	$4.40	$4.67
Average cost of bunker coal to vessels in foreign trade [8]	$4.83	$4.81	(3)
Average value of exports to all countries (at port) [9]	$3.69	$3.69	(3)
Average retail price—38 cities [10]	$8.52	$8.60	$9.15
Average railroad freight charge per net ton [11]	$2.23	$2.22	$2.22
Underground loading machinery sold: [12]			
Mobile loading machines (number)	292	233	367
Scrapers (number)	18	36	8
Conveyors, including those with duckbills (units)	1,095	1,573	1,800
Pit-car loaders (units)	2	3	10
Average number of men employed at mines operating [13]	421,788	439,075	[1] 459,000
Fuel-efficiency indicators:			
Pounds of coal per kw.-hr. at electric power plants [14]	1.39	1.35	1.34
Pounds per 1,000 gross ton-miles—railroads [15]	113	112	111

[1] Subject to revision.
[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.
[3] Figures not available for publication.
[4] Production plus imports minus exports plus or minus net changes in consumers' stocks.
[5] Association of American Railroads.
[6] Interstate Commerce Commission. Excludes freight charges.
[7] As reported by coke operators to the Bureau of Mines.
[8] Computed from records of the Department of Commerce.
[9] Computed from records of the Department of Commerce. The figure represents the average value at the point of export of shipments to all foreign countries, including Canada.
[10] Bureau of Labor Statistics.
[11] Average receipts per net ton of revenue bituminous coal and lignite originated, as reported by the Interstate Commerce Commission.
[12] Young, W. H., Anderson, R. L., Lamb, G. A., and Shore, F. M., Mechanization Sales: Coal Age, February 1942, pp. 66–68; and Min. Cong. Jour., February 1942, pp. 22–25.
[13] The figures for 1939 and 1940 are based upon reports of mine operators producing over 1,000 tons. The figure for 1941 is estimated from various sources, including the employment index of the Bureau of Labor Statistics and State mine inspectors' reports.
[14] Federal Power Commission.
[15] Interstate Commerce Commission; includes coal equivalent of fuel oil consumed.

PRODUCTION BY WEEKS AND MONTHS

TABLE 2.—*Estimated weekly production of bituminous coal and lignite in the United States in 1941*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 4, 1941	[1] 5,131,000	[1] 3	[2] 1,791,000
11	10,302,000	6	1,717,000
18	9,808,000	6	1,635,000
25	10,093,000	6	1,682,000
Feb. 1	10,265,000	6	1,711,000
8	10,249,000	6	1,708,000
15	10,576,000	6	1,763,000
22	10,577,000	6	1,763,000
Mar. 1	11,024,000	6	1,837,000
8	10,900,000	6	1,817,000
15	11,222,000	6	1,870,000
22	11,431,000	6	1,905,000
29	11,865,000	6	1,978,000
Apr. 5	3,370,000	5	674,000
12	1,085,000	6	181,000
19	1,287,000	6	215,000
26	1,577,000	6	263,000
May 3	5,076,000	6	846,000
10	9,318,000	6	1,553,000
17	10,068,000	6	1,678,000
24	10,462,000	6	1,744,000
31	9,601,000	5.4	1,778,000
June 7	9,563,000	6	1,594,000
14	10,150,000	6	1,692,000
21	10,336,000	6	1,723,000
28	11,285,000	6	1,881,000
July 5	6,822,000	3.4	2,006,000
12	9,668,000	5	1,934,000
19	10,773,000	6	1,796,000
26	10,901,000	6	1,817,000
Aug. 2	10,675,000	6	1,779,000
9	10,699,000	6	1,783,000
16	10,983,000	6	1,831,000
23	10,974,000	6	1,829,000
30	11,221,000	6	1,870,000
Sept. 6	10,010,000	5	2,002,000
13	11,483,000	6	1,914,000
20	10,410,000	6	1,735,000
27	11,386,000	6	1,898,000
Oct. 4	11,558,000	6	1,926,000
11	11,524,000	6	1,921,000
18	11,380,000	6	1,897,000
25	11,178,000	6	1,863,000
Nov. 1	10,871,000	6	1,812,000
8	11,362,000	6	1,894,000
15	11,622,000	5.6	2,075,000
22	8,843,000	5.2	1,701,000
29	11,632,000	5.8	2,006,000
Dec. 6	11,364,000	6	1,894,000
13	11,394,000	6	1,899,000
20	11,163,000	6	1,861,000
27	8,422,000	5	1,684,000
Jan. 3, 1942	[1] 6,351,000	[1] 3	[2] 1,962,000
	511,290,000	303.4	1,685,000

[1] Figures represent output and number of working days in that part of week included in calendar year shown. Total production for week of January 4, 1941, was 8,956,000 tons; for week of January 3, 1942, it was 9,844,000 tons.

[2] Average daily rate of production for entire week and not for working days in calendar year shown.

TABLE 3.—*Estimated monthly production of coal in the United States in 1941, by States, in thousands of net tons*

[Bituminous coal and lignite figures are preliminary estimates based upon railroad carloadings and river shipments of coal and beehive coke, supplemented by direct reports from a number of mining companies, local coal operators' associations, and detailed monthly production statistics compiled by the State Mine Departments of Colorado, Illinois, Pennsylvania, Washington, and West Virginia. In making the estimates, allowance is made for commercial truck shipments, local sales, and colliery fuel, and for small trucking mines producing over 1,000 tons a year. Where a mine is on the border between two States, the production is accredited to the State from which the coal is extracted, rather than the State in which the tipple is located. The estimates here given are based upon the latest information available and differ in some cases from the current figures previously published in the Weekly Coal Reports.]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,420	1,385	1,564	188	1,065	1,463	1,380	1,438	1,264	1,223	1,293	1,521	15,204
Alaska	21	14	17	19	19	15	22	22	20	24	22	26	241
Arkansas and Oklahoma	446	320	286	41	55	67	185	388	450	458	380	347	3,423
Colorado	763	620	685	304	366	373	443	488	672	697	714	780	6,905
Georgia and North Carolina	3	3	4	2	4	3	3	3	3	4	4	4	40
Illinois	5,380	5,045	5,833	860	3,996	3,864	4,578	4,604	4,718	4,930	4,842	5,550	54,200
Indiana	2,163	1,933	2,480	195	1,774	1,635	1,674	1,897	2,018	2,270	2,228	2,323	22,590
Iowa	344	292	352	130	168	168	168	177	232	278	300	341	2,950
Kansas and Missouri	773	707	820	462	375	452	510	607	636	655	678	770	7,445
Kentucky:													
Eastern	3,524	3,366	3,844	160	3,676	3,935	3,864	3,934	4,120	4,408	3,354	3,325	41,510
Western	967	975	1,090	1,420	880	723	842	900	886	957	1,020	1,105	11,765
Maryland	157	153	172	14	135	155	150	156	168	166	146	176	1,748
Michigan	52	47	45	21	7	2	8	34	36	40	38	40	370
Montana (bituminous and lignite)	300	257	225	181	184	184	219	237	289	374	372	378	3,200
New Mexico	113	106	122	85	76	99	95	90	103	112	115	134	1,250
North and South Dakota (lignite)	304	249	207	92	81	92	87	105	186	322	401	300	2,426
Ohio	2,258	2,327	2,710	272	2,462	2,565	2,625	2,774	2,930	3,107	2,840	2,820	29,690
Pennsylvania (bituminous)	11,360	10,730	12,118	236	11,675	11,463	11,255	11,882	11,576	12,672	10,190	12,313	127,470
Tennessee	567	568	637	102	563	602	585	598	620	681	585	605	6,713
Texas (bituminous and lignite)	34	30	34	30	28	31	30	31	27	37	32	24	368
Utah	424	350	345	60	233	206	238	382	450	465	400	460	4,013
Virginia	1,453	1,377	1,610	233	1,705	1,682	1,687	1,723	1,760	1,896	1,628	1,586	18,340
Washington	167	153	168	137	126	126	120	149	176	190	177	186	1,875
West Virginia	11,194	10,835	12,741	345	13,429	13,035	12,833	13,492	13,487	14,614	12,002	12,879	140,886
Wyoming	587	490	571	440	382	377	477	538	676	746	663	700	6,647
Other Western States	2	2	2	1	1	2	2	2	2	2	2	1	21
Total bituminous coal and lignite	44,776	42,334	48,682	6,030	43,465	43,319	44,080	46,651	47,505	51,328	44,426	48,694	511,290
Pennsylvania anthracite [1]	5,162	4,596	4,765	3,317	4,001	5,072	4,855	5,441	5,334	5,580	3,974	4,271	56,368
Grand total	49,938	46,930	53,447	9,347	47,466	48,391	48,935	52,092	52,839	56,908	48,400	52,965	567,658

[1] Bureau of Mines. Includes colliery fuel, dredge and washery coal, and shipments by truck from authorized operations. Includes also about 2,000,000 tons of illicit coal lawfully purchased and prepared by legitimate operators for shipment to market.

CONSUMPTION

TABLE 4.—*Changes in the United States consumption of bituminous coal and lignite by such classes of consumers as report currently and by all other consumers, 1929 and 1934–41, in thousands of net tons* [1]

[Information on several other classes of consumers is available for certain years. The items shown in this table are selected because they are available in strictly comparable form for each year]

Year	Consumed in the United States								Exported [2]—		Total of consumption and exports [8]
	Colliery fuel	Electric power utilities [3]	Bunkers, foreign trade [2]	Locomotive fuel, class I roads [4]	Coke [5]		All other uses [6]	Total consumption [7]	To Canada and Mexico	To other countries (seaborne)	
					Beehive ovens	By-product ovens					
1929	4,663	44,937	4,287	113,894	10,028	76,759	264,987	519,555	14,727	2,702	536,984
1934	3,175	33,555	1,321	70,496	1,635	44,343	192,518	347,043	10,213	656	357,912
1935	3,103	34,807	1,576	71,335	1,469	49,046	198,956	360,292	9,044	698	370,034
1936	3,227	42,025	1,622	81,130	2,698	63,244	228,850	422,796	9,912	743	433,451
1937	3,052	44,766	1,832	82,667	4,927	69,575	221,678	428,497	12,052	1,093	441,642
1938	2,493	40,212	1,352	68,794	1,360	45,266	185,173	344,650	9,561	929	355,140
1939	2,565	46,223	1,477	73,935	2,298	61,216	192,055	379,769	9,976	1,615	391,360
1940	2,443	53,398	1,426	79,628	4,803	76,583	219,969	438,250	13,537	2,929	454,716
1941 [9]	2,710	64,756	(10)	90,906	10,529	82,609	(10)	(10)	(10)	(10)	(10)

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 799.
[2] Department of Commerce.
[3] Geological Survey and Federal Power Commission. Represents all coal consumed by public utility power plants in power generation, including bituminous coal, anthracite, lignite, and a small amount of coke.
[4] Interstate Commerce Commission. Represents bituminous coal and lignite consumed as locomotive fuel by class I steam railways, excluding switching and terminal companies. In 1940, the consumption by class I line-haul railways plus the purchases by class II and class III railways plus all switching and terminal companies combined was 91,047,281 net tons of bituminous coal and lignite. Similar data for 1941 are not yet available. (Note: This is a revision of footnote 4, p. 768, Minerals Yearbook, Review of 1940.)
[5] Bureau of Mines.
[6] Obtained by subtracting the known items from the calculated total consumption. Includes general manufacturing, domestic, and many miscellaneous uses.
[7] Production plus imports minus exports, plus or minus changes in consumers' stocks.
[8] Includes imports.
[9] Subject to revision.
[10] Figures not available for publication.

STOCKS HELD BY CONSUMERS

TABLE 5.—*Stocks of bituminous coal and lignite in hands of commercial consumers and in retail dealers' yards in the United States, 1940–41*

Date	Total stock (net tons)	Days' supply at current rate of consumption on date of stock taking: Byproduct coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Retail yards	Railroads	Cement mills	Total
1940										
Jan. 1	44,571,000	37	21	40	56	60	26	23	32	34
Feb. 1	40,222,000	30	18	32	48	57	16	18	43	27
Mar. 1	39,077,000	30	21	32	45	63	16	21	52	28
Apr. 1	35,108,000	28	21	31	43	71	13	20	38	27
May 1	35,721,000	27	23	35	36	80	21	20	33	32
June 1	39,203,000	31	22	42	59	82	41	22	29	39
July 1	41,563,000	32	24	50	69	80	57	22	28	43
Aug. 1	45,438,000	35	26	56	74	80	61	25	30	47
Sept. 1	48,111,000	36	26	56	66	79	59	27	32	47
Oct. 1	51,122,000	40	28	59	62	81	50	26	32	47
Nov. 1	51,564,000	43	24	49	64	73	50	23	28	44
Dec. 1	51,872,000	45	23	44	59	75	41	23	26	41
Dec. 31	50,998,000	45	26	42	51	74	28	23	27	38
1941										
Jan. 1	50,998,000	45	26	42	51	74	28	23	27	38
Feb. 1	48,702,000	43	28	37	53	72	19	24	31	34
Mar. 1	48,518,000	43	30	35	50	69	16	26	33	32
Apr. 1	50,690,000	43	39	38	51	74	14	32	37	35
May 1 [1]	35,971,000	23	23	34	41	65	26	24	24	32
June 1	37,483,000	21	27	38	37	57	32	25	25	32
July 1	42,929,000	26	26	45	53	58	32	26	27	35
Aug. 1	47,051,000	27	27	53	69	62	34	28	30	38
Sept. 1	52,801,000	31	28	59	70	60	31	31	31	40
Oct. 1	56,994,000	32	31	61	79	63	33	33	34	42
Nov. 1	61,401,000	37	32	58	79	62	36	34	33	43
Dec. 1	61,763,000	36	30	54	78	67	34	33	34	43
Dec. 31	62,737,000	38	30	50	76	67	27	34	37	40

[1] Unadjusted for coal in transit during suspension of mining in April 1941.

FUEL EFFICIENCY

TABLE 6.—*Indicators of effect of fuel economy on consumption of coal in the United States per unit of performance since the World War of 1914–18*

	Pounds	Reduction from base period (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average:		
1919–20	170	
1940	112	34.1
1941	111	34.7
Pounds per passenger-train car-mile:		
Average:		
1919–20	18.5	
1940	15.0	18.9
1941	14.9	19.5
Electric public utility power plants:		
Pounds per kilowatt-hour:		
1919	3.2	
1940	1.4	56.3
1941	1.3	59.4
Iron and steel—pounds coking coal per gross ton of pig: [1]		
1918	3,577	
1940	2,846	20.4
1941	2,828	20.9
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–41, expressed as percent of coal used for all coke in 1941 [2]		18.9

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of byproducts, which are covered in next item.

[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER

The procedure used in making the calculations on relative rate of growth of energy is described in detail in Minerals Yearbook, Review of 1940 (p. 774).

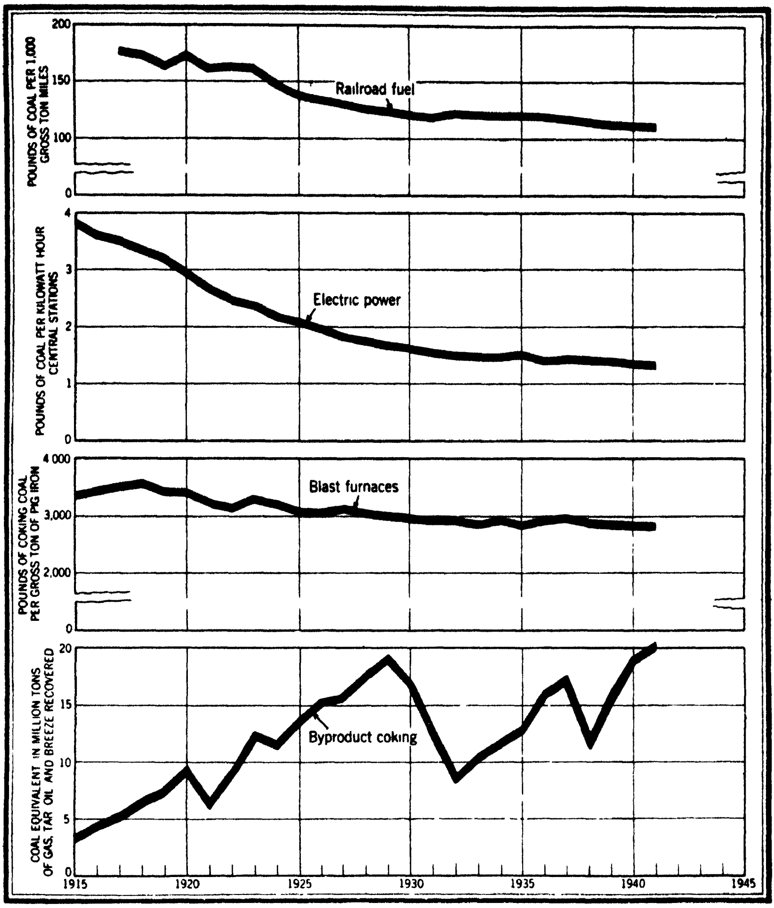

FIGURE 4.—Trends of fuel efficiency in the United States, 1915–41.

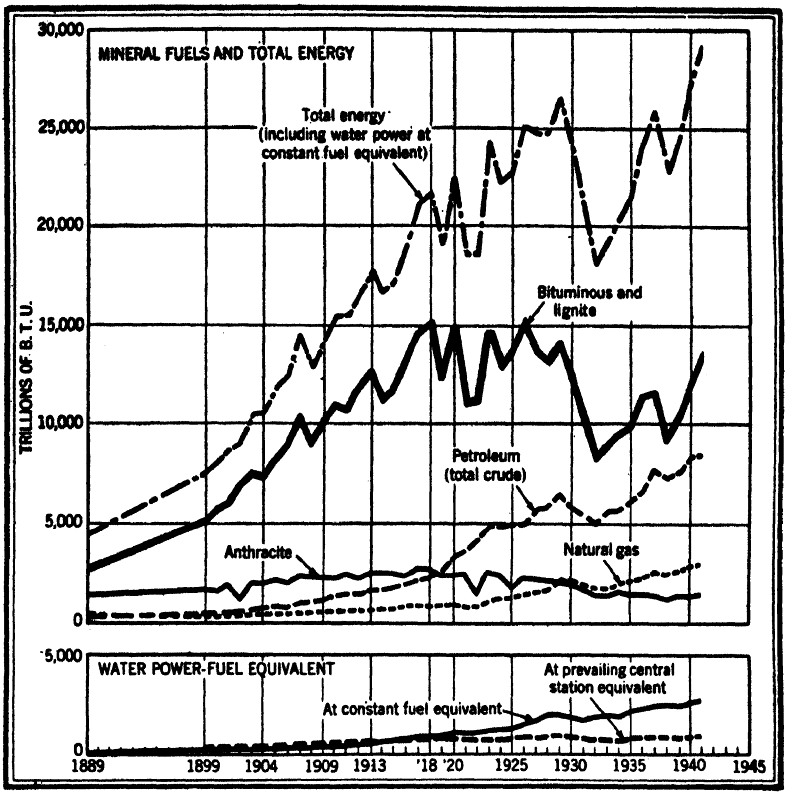

FIGURE 5.—Annual supply of energy from mineral fuels and water power in the United States, 1889-1941.

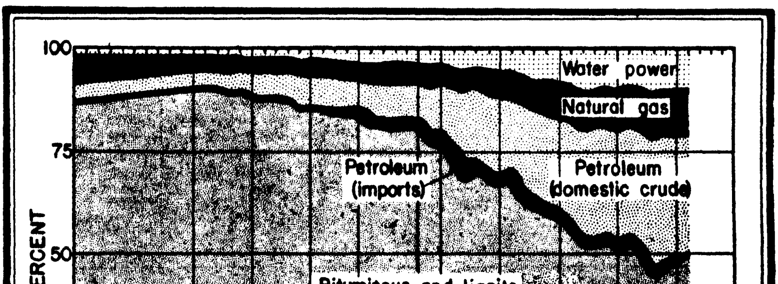

FIGURE 6.—Percentage of total B. t. u. equivalent contributed by the several sources of energy in the United States, counting water power at constant fuel equivalent, 1889-1941. If water power is counted at the prevailing fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1899 and 3.4 percent in 1941, and the proportions of the other sources of energy are affected accordingly.

TABLE 7.—*Annual supply of energy from mineral fuels and water power in the United States, 1933–41,*[1] *in trillions of B. t. u.*[2]

Year	Coal: Pennsylvania anthracite	Coal: Bituminous coal and lignite	Coal: Total	Petroleum (total crude, including that refined): Domestic production	Petroleum: Imports	Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent): At constant fuel equivalent[3]	Water power: At prevailing central station equivalent[4]	Grand total energy: Water power at constant fuel equivalent	Grand total energy: Water power at prevailing central station equivalent
1933	1,348	8,741	10,089	5,434	191	1,672	7,297	17,386	1,931	711	19,317	18,097
1934	1,555	9,415	10,970	5,448	213	1,904	7,565	18,535	1,896	698	20,431	19,233
1935	1,419	9,756	11,175	5,980	193	2,060	8,233	19,408	2,207	806	21,615	20,214
1936	1,485	11,504	12,989	6,598	194	2,330	9,122	22,111	2,256	812	24,367	22,923
1937	1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	2,446	871	25,957	24,382
1938	1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	2,466	866	22,765	21,165
1939	1,400	10,345	11,745	7,590	199	2,663	10,452	22,197	2,423	838	24,620	23,035
1940	1,400	12,072	13,472	8,119	256	2,860	11,235	24,707	2,620	880	27,327	25,587
1941 [5]	1,478	13,396	14,874	8,425	(6)	2,978	[6] 11,403	[6] 26,277	2,804	934	[6] 29,081	[6] 27,211

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 807.
[2] The unit heat values employed are: Anthracite, 13,600 B. t. u. per pound; bituminous coal and lignite, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as is true of all public utility plants since 1919. Otherwise the fuel equivalent is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for manufacturers and mines and of 40 percent for public utilities.
[3] Assuming 4.02 pounds per kilowatt-hour, which is average of central-electric-station practice in 1913, the base period used.
[4] Assuming the average central-station practice for each of the years for which data are available, which declined from about 7.05 pounds per kilowatt-hour in 1899 to 1.34 pounds in 1941.
[5] Subject to revision.
[6] Excludes imports of petroleum. Figures not available for publication.

TABLE 8.—*Index numbers for relative rate of growth of coal, oil, and water power in the United States, 1933–41*[1]

[The figures are expressed as a percentage of the 1918 rate]

Year	Coal: Pennsylvania anthracite	Coal: Bituminous coal and lignite	Coal: Total	Petroleum (total crude): Domestic production	Petroleum: Imports	Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (at constant fuel equivalent)	Grand total: With water power at constant fuel equivalent	Grand total: With water power at prevailing central station equivalent
1933	50	57	56	252	90	205	229	82	231	87	83
1934	58	62	61	255	94	246	241	88	227	94	89
1935	53	64	63	280	85	266	262	92	264	99	93
1936	55	76	73	309	86	301	291	105	270	112	106
1937	52	77	73	359	73	334	332	112	292	119	112
1938	47	60	58	341	70	318	316	97	295	104	98
1939	52	68	66	335	88	344	333	106	289	113	106
1940	52	80	75	380	113	369	358	118	313	125	118
1941 [2]	55	88	83	394	(3)	384	[3] 364	[3] 125	335	[3] 133	[3] 125

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 809.
[2] Subject to revision.
[3] Excludes imports of crude petroleum. Figures not available for publication.

TABLE 9.—*Percentage of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States, 1933–41* [1]

Year	Coal: Pennsylvania anthracite	Coal: Bituminous coal and lignite	Coal: Total	Petroleum (total crude): Domestic production	Petroleum (total crude): Imports	Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power, fuel equivalent	Grand total, including water power
	Water power counted at *constant* fuel equivalent of approximately 4 lbs. per kilowatt-hour									
1933	7.0	45.2	52.2	28.1	1.0	8.7	37.8	90.0	10.0	100.0
1934	7.6	46.1	53.7	26.7	1.0	9.3	37.0	90.7	9.3	100.0
1935	6.6	45.1	51.7	27.7	.9	9.5	38.1	89.8	10.2	100.0
1936	6.1	47.2	53.3	27 1	.8	9.5	37.4	90.7	9.3	100.0
1937	5.4	45.0	50.4	29.6	.6	10.0	40.2	90.6	9.4	100.0
1938	5.5	40.1	45.6	32.0	.7	10.8	43.5	89.1	10.9	100.0
1939	5.7	42.0	47.7	30.8	.8	10.8	42.4	90.1	9.9	100.0
1940	5.1	44.2	49.3	29.7	.9	10.5	41.1	90.4	9.6	100.0
1941 [2]	5.1	46.1	51.2	29.0	(3)	10.2	39.2	90.4	9.6	100.0
	Water power counted at *prevailing* central-station equivalent for year									
1933	7.4	48.4	55.8	30 0	1.1	9.2	40.3	96.1	3.9	100.0
1934	8.1	49.0	57.1	28.3	1.1	9.9	39.3	96.4	3.6	100.0
1935	7.0	48 3	55.3	29.5	1.0	10.2	40.7	96.0	4.0	100.0
1936	6.5	50.2	56 7	28.8	.8	10.2	39.8	96 5	3.5	100.0
1937	5.8	47.8	53.6	31 5	.7	10.6	42.8	96.4	3.6	100.0
1938	5.9	43.2	49.1	34 4	.7	11.7	46.8	95.9	4.1	100.0
1939	6.1	44.9	51.0	32.9	.9	11.6	45.4	96.4	3.6	100.0
1940	5.5	47.2	52.7	31.7	1.0	11.2	43.9	96.6	3.4	100.0
1941 [2]	5.5	49.2	54.7	31.0	(3)	10.9	41.9	96.6	3.4	100.0

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 810.
[2] Subject to revision. Percentages based upon figures in table 7.
[3] Figures not available for publication.

FINAL BITUMINOUS COAL AND LIGNITE STATISTICS FOR 1939 AND 1940

SUMMARY BY STATES

TABLE 10.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States*

[Exclusive of mines producing less than 1,000 tons]

State	Disposition of coal produced (net tons)						Average value per ton [4]	Average number of wage earners and working proprietors on active days (excluding shut-down periods)				Average number of full days mines were active	Tons of coal produced on active days per man-shift
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine [3]	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity		Underground	Surface		Total		
									In strip pits	All others			
Alabama	11,210,512	672,803	119,431	72,707	−28,778	12,046,675	$2.30	17,943	90	2,851	20,884	183	3.16
Alaska	143,549		10	3,305	+1,553	148,417	2.82	66		22	88	289	5.84
Arizona, Georgia, Idaho, and Oregon	22,706	14,710	496	376	+733	39,021	2.96	122		35	157	154	1.61
Arkansas	1,093,527	48,869	2,130	7,548	−36	1,152,038	3.17	3,362	45	597	4,004	107	2.70
Colorado	4,079,665	1,533,860	82,266	[3] 244,879	−17,460	5,923,210	2.47	6,782	(5)	(5)	8,161	176	4.12
Illinois	38,964,079	6,770,843	401,482	723,853	−77,566	46,782,691	1.64	27,198	1,761	6,935	35,894	163	7.98
Indiana	14,376,418	1,920,025	475,007	153,217	+18,105	16,942,772	1.48	5,338	2,140	2,288	9,766	177	9.79
Iowa	1,408,854	1,478,839	43,383	11,649	+4,832	2,947,557	2.44	5,220	322	709	6,251	147	3.20
Kansas	2,411,643	247,792	8,226	13,576	−6,546	2,674,691	1.89	1,772	525	561	2,858	178	5.25
Kentucky	40,520,860	1,253,787	595,201	164,342	+22,378	42,556,568	1.74	43,881	93	6,667	50,641	180	4.68
Maryland	1,188,237	236,534	9,702	8,480	−225	1,442,728	2.04	2,057		294	2,351	178	3.44
Michigan	122,215	295,340	8,160	26,717	+4,322	456,754	3.77	1,038		116	1,154	155	2.55
Missouri	2,266,617	956,453	21,879	31,049	−2,448	3,273,550	1.88	3,135	672	686	4,493	158	4.60
Montana:													
Bituminous coal	2,596,600	145,979	8,060	4,370	+1,027	2,756,036	1.46	1,034	(5)	(5)	1,383	168	11.87
Lignite [6]	5,410	41,190	1,018	95		47,713	1.59	55	(5)	(5)	85	155	3.61
Total Montana [6]	2,602,010	187,169	9,078	4,465	+1,027	2,803,749	1.46	1,089	(5)	(5)	1,468	167	11.42
New Mexico	1,057,971	113,181	13,259	36,828	+8,821	1,230,060	2.85	1,799		400	2,199	166	3.37
North Dakota (lignite) [6]	1,522,676	403,763	136,281	9,773		2,072,493	1.18	560	305	349	1,214	189	9.04
Ohio	15,380,081	4,655,388	171,927	98,141	−15,984	20,289,553	1 63	17,657	1,050	2,935	21.642	175	5.35
Oklahoma	1,049,020	123,815	2,219	13,400	−892	1,187,562	2.11	1,510	144	378	2,032	133	4.39
Pennsylvania	81,915,541	5,604,283	2,855,031	[3] 2,043,430	+165,828	92,584,113	2.03	96,732	1,219	12,395	110,346	176	4.77
South Dakota (lignite) [6]	26,959	20,623	190	10		47,782	1.35	1	(5)	(5)	31	219	7.03
Tennessee	4,780,347	311,636	55,704	34,643	+3,151	5,185,481	1.95	6,777	(5)	(5)	7,925	178	3.68

Texas:													
Bituminous coal	9,554	6,073	6	463	+163	16,259	3.23	175		61	236	44	1.55
Lignite [6]	793,647	7,914	4,478	4,019		810,058	1.07	475	([5])	([5])	559	236	6.14
Total Texas [6]	803,201	13,987	4,484	4,482	+163	826,317	1.12	650	([5])	([5])	795	179	5.80
Utah	2,898,469	347,403	22,839	[3] 21,087	−4,894	3,284,904	2.14	1,861	([5])	([5])	2,544	171	7.53
Virginia	12,910,240	221,738	73,986	[3] 317,434	+7,576	13,530,974	1.85	13,814		1,811	15,625	186	4.66
Washington	1,252,241	393,518	51,303	15,911	−22,531	1,690,442	3.11	1,755	([5])	([5])	2,275	191	3.90
West Virginia	104,404,593	1,510,183	1,827,043	[3] 494,527	+125,588	108,361,934	1.76	88,410	269	14,554	103,233	190	5.51
Wyoming	5,006,753	197,282	54,712	98,922	+15,620	5,373,289	2.00	2,947	53	757	3,757	207	6.92
Total United States [6]	353,418,984	29,533,824	7,045,429	[3] 4,654,751	+202,337	394,855,325	1.84	353,476	8,791	59,521	421,788	178	5.25

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mines to points of use by conveyor, chute, or aerial tramway.

[3] Includes coal made into beehive coke at mines in following States Colorado, 97,591 tons; Pennsylvania, 1,554,179 tons; Utah, 13,825 tons; Virginia, 292,152 tons; and West Virginia, 131,728 tons—grand total, 2,089,475 tons.

[4] Value of all coal produced, f. o. b. mine or cleaning plant, excluding selling cost. The value of cleaned coal, rather than that of raw coal, was used in cases of operations that cleaned coal.

[5] Not shown separately to avoid disclosure of individual operations.

[6] Estimate made from various sources on disposition of lignite has been included for comparative purposes; lignite schedule did not ask for this break-down.

TABLE 11.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States*

[Exclusive of mines producing less than 1,000 tons]

State	Disposition of coal produced (net tons)					Average value per ton [4]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine [3]	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
Alabama	14,252,563	854,403	131,864	85,333	15,324,163	$2.33	20,068	94	3,314	23,476	219	5,136,191	2.98
Alaska	170,174			3,670	173,844	3.49	70		28	98	322	31,541	5.51
Arizona, Idaho, and Oregon		16,816	67	19	16,902	3.32	37		9	46	210	9,663	1.75
Arkansas	1,374,688	69,083	2,309	7,531	1,453,611	3.36	3,194	58	623	3,875	136	527,621	2.76
Colorado	4,648,238	1,635,322	98,058	[3] 207,124	6,588,742	2.53	6,463	23	1,350	7,836	188	1,473,647	4.47
Georgia	35,082	5,531	1,016	678	42,307	2.38	96		34	130	217	28,248	1.50
Illinois	41,805,361	7,657,553	406,845	740,671	50,610,430	1.69	27,067	1,729	7,362	36,158	169	6,119,358	8.27
Indiana	16,023,001	2,272,043	426,429	147,099	18,868,572	1.53	5,085	1,751	2,819	9,655	188	1,815,165	10.39
Iowa	1,424,398	1,755,138	37,736	13,905	3,231,177	2.49	5,061	370	790	6,221	158	985,478	3.28
Kansas	3,226,456	333,673	10,449	8,374	3,578,952	1.88	1,601	474	739	2,814	196	550,869	6.50
Kentucky	46,501,483	1,868,325	618,142	[3] 152,954	49,140,904	1.85	47,442	100	7,254	54,796	200	10,986,433	4.47
Maryland	1,176,578	311,386	10,810	4,659	1,503,433	2.11	2,054		285	2,339	182	424,936	3.54
Michigan	103,082	274,058	8,795	24,234	410,169	3.88	773		97	870	187	163,091	2.51
Missouri	1,760,616	1,280,577	23,989	31,559	3,096,741	2.04	2,920	618	684	4,222	170	718,755	4.31
Montana:													
Bituminous coal	2,638,636	168,279	8,948	3,073	2,818,936	1.45	935	48	344	1,327	189	251,412	11.21
Lignite [5]	5,472	41,666	1,030	96	48,264	[6] 1.78	60	8	16	84	161	13,499	3.58
Total Montana	2,644,108	209,945	9,978	3,169	2,867,200	1.45	995	56	360	1,411	188	264,911	10.82
New Mexico	948,866	114,407	10,952	36,390	1,110,615	2.97	1,562		396	1,958	168	328,416	3.38
North Dakota (lignite) [5]	1,566,976	508,119	116,946	26,393	2,218,434	[6] 1.17	654	371	352	1,377	182	251,216	8.83
Ohio	17,515,476	5,085,213	104,210	66,653	22,771,552	1.71	16,893	1,227	3,054	21,174	193	4,076,578	5.59
Oklahoma	1,417,960	209,039	2,730	16,252	1,645,981	2.44	1,471	183	394	2,048	176	359,675	4.58
Pennsylvania	101,326,985	7,610,566	3,975,536	[3] 3,689,912	116,602,999	2.04	102,996	1,685	13,739	118,420	212	25,115,380	4.64
South Dakota (lignite) [5]	37,285	28,521	264	15	66,085	[6] 1.33	12	39	12	63	168	10,577	6.25
Tennessee	5,512,746	384,823	67,946	[3] 42,941	6,008,456	2.00	7,413	3	1,150	8,566	208	1,779,057	3.38

Texas:													
Bituminous coal	8,530	5,565	42		14,137	3.42	67		14	81	99	8,003	1.77
Lignite [5]	592,720	6,784	3,650	3,264	606,418	[6] 1.05	476	16	54	546	170	92,615	6.55
Total Texas	601,250	12,349	3,692	3,264	620,555	1.10	543	16	68	627	160	100,618	6.17
Utah	3,112,429	416,221	20,963	[3] 25,973	3,575,586	2.20	1,882		708	2,590	182	471,606	7.58
Virginia	14,582,734	321,963	91,306	[3] 352,072	15,348,075	1.95	14,793	5	2,222	17,020	199	3,391,223	4.53
Washington	1,219,092	373,607	44,001	13,652	1,650,352	3.16	1,838	5	482	2,325	188	436,530	3.78
West Virginia	121,411,168	1,744,018	2,598,170	[3] 684,265	126,437,621	1.83	88,684	127	15,924	104,735	215	22,560,069	5.60
Wyoming	5,481,937	187,777	39,050	99,278	5,808,042	2.06	3,346	49	830	4,225	173	733,036	7.92
Total United States	409,880,732	35,540,476	8,862,253	[3] 6,488,039	460,771,500	1.91	365,013	8,983	65,079	439,075	202	88,849,888	5.19

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mines to points of use by conveyor, chute, or aerial tramway.

[3] Includes coal made into beehive coke at mines in following States: Colorado, 95,735 tons; Kentucky, 1,273 tons; Pennsylvania, 3,239,464 tons; Tennessee, 8,818 tons; Utah, 14,537 tons; Virginia, 330,818 tons; and West Virginia, 354,405 tons—grand total, 4,045,050 tons.

[4] Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[5] Figures on lignite compiled by Bureau of Mines; see lignite tables, 1940, at end of this chapter. As lignite schedule did not require exactly same break-down on disposition of coal produced as shown in this table, an estimate has been made where feasible for items "shipped by truck or wagon" and "used by mine employees, taken by locomotive tenders at tipple, or other uses at mine." Sum of these items equals sum of items "commercial sales by truck or wagon" and "other sales to local trade, or used by employees, or taken by locomotives at tipple," as published by Bureau of Mines.

[6] Lignite figures exclude selling cost.

PRODUCTION BY WEEKS AND MONTHS

TABLE 12.—*Bituminous coal and lignite produced in the United States in 1939, with estimates by weeks*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 7	7,815,000	5.1	1,532,000	July 15	7,080,000	6	1,180,000
14	8,159,000	6	1,360,000	22	7,150,000	6	1,192,000
21	8,338,000	6	1,390,000	29	7,437,000	6	1,240,000
28	8,759,000	6	1,460,000	Aug. 5	7,407,000	6	1,235,000
Feb. 4	8,256,000	6	1,376,000	12	7,565,000	6	1,261,000
11	8,819,000	6	1,470,000	19	7,552,000	6	1,259,000
18	8,706,000	6	1,451,000	26	7,861,000	6	1,310,000
25	8,777,000	5.9	1,488,000	Sept. 2	8,247,000	6	1,374,000
Mar. 4	8,624,000	6	1,437,000	9	7,816,000	5	1,563,000
11	8,186,000	6	1,364,000	16	9,100,000	6	1,517,000
18	7,832,000	6	1,305,000	23	9,384,000	6	1,564,000
25	7,574,000	6	1,262,000	30	10,254,000	6	1,709,000
Apr. 1	7,158,000	5.3	1,351,000	Oct. 7	10,507,000	6	1,751,000
8	1,702,000	6	284,000	14	10,761,000	6	1,794,000
15	1,974,000	6	329,000	21	10,731,000	6	1,789,000
22	2,696,000	6	449,000	28	10,708,000	6	1,785,000
29	3,437,000	6	573,000	Nov. 4	10,632,000	6	1,772,000
May 6	2,820,000	6	470,000	11	10,321,000	5.6	1,843,000
13	1,091,000	6	182,000	18	10,196,000	6	1,699,000
20	5,114,000	6	852,000	25	9,322,000	5.1	1,828,000
27	6,182,000	6	1,030,000	Dec. 2	9,162,000	5.9	1,553,000
June 3	5,834,000	5.4	1,080,000	9	9,257,000	6	1,543,000
10	6,349,000	6	1,058,000	16	9,025,000	6	1,504,000
17	6,406,000	6	1,068,000	23	9,318,000	6	1,553,000
24	6,418,000	6	1,070,000	30	8,396,000	5	1,679,000
July 1	6,711,000	6	1,119,000				
8	5,929,000	5	1,186,000		394,855,000	305.3	1,293,000

TABLE 13.—*Bituminous coal and lignite produced in the United States in 1940, with estimates by weeks*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 6	9,077,000	5.1	1,780,000	July 20	7,906,000	6	1,318,000
13	10,232,000	6	1,705,000	27	8,229,000	6	1,372,000
20	10,120,000	6	1,687,000	Aug. 3	8,355,000	6	1,393,000
27	10,531,000	6	1,755,000	10	8,685,000	6	1,448,000
Feb. 3	10,371,000	6	1,729,000	17	9,062,000	6	1,510,000
10	10,090,000	6	1,682,000	24	9,029,000	6	1,505,000
17	9,242,000	6	1,540,000	31	9,222,000	6	1,537,000
24	9,259,000	5.9	1,569,000	Sept. 7	8,084,000	5	1,617,000
Mar. 2	8,943,000	6	1,491,000	14	9,291,000	6	1,549,000
9	8,309,000	6	1,385,000	21	9,473,000	6	1,579,000
16	8,581,000	6	1,430,000	28	10,373,000	6	1,729,000
23	8,146,000	6	1,358,000	Oct. 5	8,911,000	6	1,485,000
30	8,560,000	6	1,427,000	12	8,491,000	6	1,415,000
Apr. 6	7,067,000	5.1	1,386,000	19	8,432,000	6	1,405,000
13	7,784,000	6	1,297,000	26	8,962,000	6	1,494,000
20	7,409,000	6	1,235,000	Nov. 2	8,817,000	6	1,470,000
27	7,977,000	6	1,330,000	9	9,127,000	5.5	1,659,000
May 4	8,124,000	6	1,354,000	16	9,907,000	5.5	1,801,000
11	7,945,000	6	1,324,000	23	9,597,000	5.2	1,846,000
18	7,665,000	6	1,278,000	30	9,876,000	5.8	1,703,000
25	7,966,000	6	1,328,000	Dec. 7	10,033,000	6	1,672,000
June 1	7,575,000	5.4	1,403,000	14	10,047,000	6	1,675,000
8	8,096,000	6	1,349,000	21	10,105,000	6	1,684,000
15	7,888,000	6	1,315,000	28	8,094,000	5	1,619,000
22	8,025,000	6	1,338,000	Jan. 4, 1941	[1] 3,825,000	[1] 2	[2] 1,791,000
29	8,199,000	6	1,367,000				
July 6	7,277,000	5	1,455,000		460,772,000	306.5	1,503,000
13	8,381,000	6	1,397,000				

[1] Figures represent output and number of working days in that part of week included in calendar year shown. Total production for week of January 4, 1941, was 8,956,000 tons.

[2] Average daily production for entire week and not for working days in calendar year shown.

TABLE 14.—*Coal produced in the United States in 1939, by States, with estimates by months, in thousands of net tons*

[Totals for year based upon final complete returns to Bituminous Coal Division from all operators known to have produced more than 1,000 tons in year. Apportionment of known yearly total among 12 months based upon best information available—in some States upon direct tonnage reports by operators to State mine department but in most cases upon current records of railway carloadings and waterway shipments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1, 202	1, 150	1, 273	134	370	970	992	1, 058	1, 072	1, 260	1, 262	1, 304	12, 047
Alaska	12	11	11	12	13	15	9	12	15	15	12	11	148
Arkansas	128	132	65	8	7	6	22	149	178	198	125	134	1, 152
Colorado	672	671	551	418	197	218	244	400	518	694	682	658	5, 923
Illinois	4, 939	4, 903	4, 490	3, 827	2, 512	1, 943	2, 423	3, 220	3, 882	5, 100	4, 722	4, 822	46, 783
Indiana	1, 756	1, 697	1, 715	1, 535	875	811	895	1, 112	1, 364	1, 732	1, 717	1, 734	16, 943
Iowa	323	316	321	259	114	116	151	208	244	309	285	302	2, 948
Kansas	262	300	213	183	90	80	135	220	264	321	303	304	2, 675
Kentucky: Eastern	2, 972	2, 763	2, 868	252	1, 490	3, 034	3, 088	3, 556	3, 723	4, 161	3, 547	2, 812	34, 266
Western	826	860	721	818	524	335	409	600	724	827	799	848	8, 291
Maryland	142	126	170	2	83	109	92	113	128	164	159	155	1, 443
Michigan	53	48	59	4	12	19	9	34	48	57	59	55	457
Missouri	380	364	314	280	170	122	167	194	250	352	332	348	3, 273
Montana (bituminous coal and lignite)	272	265	232	171	162	180	162	210	237	335	301	277	2, 804
New Mexico	135	123	117	114	80	58	84	91	88	117	114	109	1, 230
North Dakota (lignite)	238	286	175	86	60	67	66	79	185	358	256	216	2, 072
Ohio	1, 984	1, 809	2, 061	241	850	1, 537	1, 540	1, 812	1, 923	2, 412	2, 197	1, 923	20, 289
Oklahoma	133	129	75	54	29	26	34	116	125	179	155	133	1, 188
Pennsylvania (bituminous)	8, 082	7, 706	8, 731	152	3, 752	7, 095	7, 147	8, 231	9, 217	11, 502	11, 260	9, 709	92, 584
South Dakota (lignite)	5	5	3	1	2	2	1	1	5	9	7	7	48
Tennessee	483	491	477	147	253	380	422	475	489	569	523	476	5, 185
Texas (bituminous coal and lignite)	66	61	66	62	66	66	74	80	78	71	70	66	826
Utah	344	376	264	197	96	133	132	213	366	445	387	332	3, 285
Virginia	1, 189	1, 077	1, 125	185	675	1, 148	1, 133	1, 338	1, 424	1, 642	1, 415	1, 180	13, 531
Washington	155	156	160	134	90	110	103	124	164	174	172	148	1, 690
West Virginia	9, 017	8, 350	9, 252	237	5, 360	9, 379	9, 587	11, 077	11, 362	12, 976	12, 058	9, 707	108, 362
Wyoming	485	470	445	429	225	318	349	443	553	613	574	469	5, 373
Other States [1]	4	4	5	3	3	2	1	1	4	4	4	4	39
Total bituminous coal and lignite	36, 259	34, 649	35, 959	9, 945	18, 160	28, 279	29, 471	35, 167	38, 630	46, 596	43, 497	38, 243	394, 855
Pennsylvania anthracite [2]	5, 019	4, 169	3, 652	5, 367	5, 141	3, 577	2, 951	3, 883	4, 840	4, 985	3, 989	3, 914	51, 487
Grand total	41, 278	38, 818	39, 611	15, 312	23, 301	31, 856	32, 422	39, 050	43, 470	51, 581	47, 486	42, 157	446, 342

[1] Arizona, Georgia, Idaho, and Oregon.
[2] Pennsylvania anthracite figures from Bureau of Mines. Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

TABLE 15.—*Coal produced in the United States in 1940, by States, with estimates by months, in thousands of net tons*

[Totals for year based upon final complete returns to Bituminous Coal Division from all operators known to have produced more than 1,000 tons in year. Apportionment of known yearly total among 12 months based upon best information available—in some States upon direct tonnage reports by operators to State mine department but in most cases upon current records of railway carloadings and waterway shipments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,345	1,332	1,246	1,250	1,317	1,206	1,199	1,272	1,173	1,345	1,259	1,380	15,324
Alaska	11	10	11	12	14	16	16	18	18	17	16	15	174
Arkansas	280	161	60	18	27	23	67	168	177	135	168	170	1,454
Colorado	940	681	473	419	344	252	313	458	566	561	776	806	6,589
Georgia	4	5	4	4	3	2	2	1	3	4	5	5	42
Illinois	6,115	5,205	4,448	3,244	3,075	2,906	3,146	3,943	4,085	4,169	4,741	5,533	50,610
Indiana	2,142	1,925	1,574	1,316	1,220	1,114	1,196	1,527	1,567	1,463	1,742	2,083	18,869
Iowa	422	328	256	203	200	189	193	230	272	261	324	353	3,231
Kansas	469	407	252	203	203	184	217	300	286	283	345	430	3,579
Kentucky: Eastern	3,909	3,552	2,955	3,133	3,513	3,202	3,503	3,666	3,335	3,270	3,199	3,109	40,346
Western	1,339	984	705	568	512	440	543	692	722	644	772	874	8,795
Maryland	169	161	139	116	104	93	100	116	107	122	129	147	1,503
Michigan	62	56	53	31	9	6	9	31	35	40	39	39	410
Missouri	483	340	298	179	148	143	157	187	261	247	307	347	3,097
Montana (bituminous coal and lignite)	287	244	191	206	202	177	191	217	210	287	335	320	2,867
New Mexico	128	105	77	91	84	82	84	75	81	90	98	116	1,111
North Dakota (lignite)	313	208	174	116	76	57	76	96	139	282	391	290	2,218
Ohio	2,156	1,958	1,783	1,618	1,835	1,880	2,002	2,048	1,914	1,700	1,876	2,002	22,772
Oklahoma	248	191	79	45	49	58	94	151	160	146	200	225	1,646
Pennsylvania (bituminous)	10,223	9,110	8,864	8,245	8,907	8,728	9,758	10,188	10,270	11,135	10,575	10,600	116,603
South Dakota (lignite)	11	7	5	2	1	1	1	1	5	10	13	9	66
Tennessee	593	566	464	532	527	442	470	497	477	460	465	515	6,008
Texas (bituminous coal and lignite)	64	72	50	63	64	61	49	44	39	39	38	38	621
Utah	432	274	223	195	160	157	205	337	373	345	426	449	3,576
Virginia	1,474	1,323	1,187	1,173	1,330	1,140	1,299	1,345	1,294	1,304	1,227	1,252	15,348
Washington	178	131	117	116	102	111	115	127	147	143	181	182	1,650
West Virginia	11,278	10,102	9,731	9,824	11,071	9,971	11,086	11,482	11,066	10,289	10,383	10,155	126,438
Wyoming	632	482	411	397	363	299	400	438	511	570	649	656	5,808
Other States [1]	2	1	1	1	([2])	([2])	([2])	([2])	2	3	3	4	17
Total bituminous coal and lignite	45,709	39,921	35,831	33,320	35,460	32,940	36,491	39,655	39,295	39,364	40,682	42,104	460,772
Pennsylvania anthracite [3]	5,783	3,648	3,881	3,853	4,070	4,492	4,534	3,883	4,172	4,355	3,980	4,834	51,485
Grand total	51,492	43,569	39,712	37,173	39,530	37,432	41,025	43,538	43,467	43,719	44,662	46,938	512,257

[1] Arizona, Idaho, and Oregon.
[2] Less than 500 tons.
[3] Pennsylvania anthracite figures from Bureau of Mines. Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

NUMBER AND SIZE OF MINES

TABLE 16.—*Number and production of bituminous coal and lignite mines in the United States in 1939, classified by size of output in each State*

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A, over 500,000 net tons		Class 1B, 200,000–500,000 net tons		Class 2, 100,000–200,000 net tons		Class 3, 50,000–100,000 net tons		Class 4, 10,000–50,000 net tons		Class 5, less than 10,000 net tons		Total, all classes	
	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)
Alabama	6	4,096,606	10	3,402,472	16	2,218,121	20	1,450,844	23	442,743	156	435,889	231	12,046,675
Alaska							[1] 3	[1] 148,417					3	148,417
Arizona, Georgia, Idaho, and Oregon									1	24,280	5	14,741	6	39,021
Arkansas					1	104,739	2	116,979	34	782,718	41	147,602	78	1,152,038
Colorado			2	718,422	18	2,457,914	13	995,103	52	1,333,148	126	418,623	211	5,923,210
Illinois	38	27,999,401	28	9,810,830	19	2,810,048	34	2,481,080	115	2,584,226	312	1,097,106	546	46,782,691
Indiana	10	6,941,324	13	4,506,052	14	2,159,415	18	1,354,974	61	1,375,418	150	605,589	266	16,942,772
Iowa			2	501,652	1	131,943	11	761,148	44	874,297	213	678,517	271	2,947,557
Kansas			6	1,551,740	3	386,046	3	251,186	11	201,697	70	284,022	93	2,674,691
Kentucky	10	9,670,238	50	15,729,915	70	9,977,836	64	4,656,509	71	1,873,194	213	648,876	478	42,556,568
Maryland					3	491,851	3	215,049	19	552,113	58	183,715	83	1,442,728
Michigan					1	164,130	1	87,110	9	205,514			11	456,754
Missouri			4	1,501,222	3	390,141	2	147,930	39	799,119	132	435,138	180	3,273,550
Montana:														
Bituminous coal	1	1,160,734	3	1,137,102	2	252,228			3	79,570	50	126,402	59	2,756,036
Lignite									1	11,600	16	36,113	17	47,713
Total Montana	1	1,160,734	3	1,137,102	2	252,228			4	91,170	66	162,515	76	2,803,749
New Mexico			2	475,628	3	380,027	2	150,772	6	119,107	29	104,526	42	1,230,060
North Dakota (lignite)			4	1,090,851	2	345,574	2	167,461	10	204,182	84	264,425	102	2,072,493
Ohio	9	7,006,827	15	5,046,507	20	2,856,280	23	1,627,280	104	2,243,242	485	1,509,417	656	20,289,553
Oklahoma			1	249,434	1	104,150	2	155,381	22	466,261	62	212,336	88	1,187,562
Pennsylvania	58	45,617,268	70	22,626,917	77	10,453,650	73	5,294,085	263	6,082,080	717	2,510,113	1,258	92,584,113
South Dakota (lignite)									1	42,230	3	5,552	4	47,782
Tennessee			8	2,194,642	11	1,600,505	10	742,687	18	424,743	76	222,904	123	5,185,481
Texas:														
Bituminous coal											4	16,259	4	16,259
Lignite	1	685,666							6	121,039	1	3,353	8	810,058
Total Texas	1	685,666							6	121,039	5	19,612	12	826,317
Utah	2	1,025,542	4	1,305,471	2	204,780	5	422,879	10	223,780	28	102,452	51	3,284,904
Virginia	7	4,965,069	15	4,594,553	17	2,481,412	13	977,047	14	372,427	46	140,466	112	13,530,974
Washington			2	461,813	4	637,308	2	180,554	13	298,209	31	112,558	52	1,690,442
West Virginia	62	46,310,221	123	36,371,451	108	15,976,449	80	6,190,743	104	2,759,532	244	753,538	721	108,361,934
Wyoming	1	557,378	10	3,240,728	8	1,116,766	1	50,398	11	367,248	35	100,771	66	5,373,289
Total United States	205	156,036,274	372	116,517,402	404	57,701,313	[1] 387	[1] 28,625,616	1,065	24,803,717	3,387	11,171,003	5,820	394,855,325

[1] Figures for Alaska include output from 2 mines in Class 3 and 1 smaller mine that cannot be shown separately.

TABLE 17.—*Number and production of bituminous coal and lignite mines in the United States in 1940, classified by size of output in each State*

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A, over 500,000 net tons		Class 1B, 200,000-500,000 net tons		Class 2, 100,000-200,000 net tons		Class 3, 50,000-100,000 net tons		Class 4, 10,000-50,000 net tons		Class 5, less than 10,000 net tons		Total, all classes	
	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)	Number of mines	Production (net tons)
Alabama	9	6,658,988	11	3,568,010	20	2,811,977	17	1,278,541	25	495,104	186	511,543	268	15,324,163
Alaska					(1)	(1)	[1] 3	[1] 173,844			(1)	(1)	3	173,844
Arizona, Idaho, and Oregon											7	16,902	7	16,902
Arkansas							7	475,769	32	835,980	42	141,862	81	1,453,611
Colorado	1	668,324	5	1,119,819	15	2,134,726	14	1,038,346	50	1,207,684	131	419,843	216	6,588,742
Georgia									1	36,847	2	5,460	3	42,307
Illinois	39	31,988,644	26	9,499,254	22	3,131,163	25	1,724,170	130	3,126,009	306	1,141,190	548	50,610,430
Indiana	13	9,202,528	12	4,102,055	13	2,175,182	19	1,335,192	61	1,446,541	159	607,074	277	18,868,572
Iowa			2	474,529	3	397,588	7	510,707	63	1,161,138	201	687,215	276	3,231,177
Kansas	1	695,074	7	1,819,721	2	260,976	3	242,222	18	289,611	62	271,348	93	3,578,952
Kentucky	17	15,107,343	54	16,536,510	74	10,539,143	51	3,729,091	85	2,240,998	350	987,819	631	49,140,904
Maryland			1	204,575	2	302,571	4	248,808	22	536,201	65	211,278	94	1,503,433
Michigan					1	160,122	1	83,283	8	166,764			10	410,169
Missouri			3	1,096,156	4	496,705	2	130,705	38	851,185	152	521,990	199	3,096,741
Montana (bituminous coal)	1	1,124,932	3	1,174,791	2	279,621			4	107,090	49	132,502	59	2,818,936
Montana, North Dakota, South Dakota, and Texas (lignite)			5	1,681,021	2	331,292	3	234,576	15	298,367	183	393,945	208	2,939,201
New Mexico			2	482,290	1	135,755	4	253,322	5	119,507	28	119,741	40	1,110,615
Ohio	11	9,375,299	14	4,586,583	27	3,676,542	23	1,361,938	108	2,367,419	441	1,403,771	624	22,771,552
Oklahoma			1	311,174	3	353,290	3	179,537	25	558,804	72	243,176	104	1,645,981
Pennsylvania	69	66,862,841	66	21,418,646	82	12,159,558	91	6,629,269	299	6,724,482	807	2,808,203	1,414	116,602,999
Tennessee			10	2,931,186	10	1,484,965	12	883,514	21	486,998	71	221,793	124	6,008,456
Texas (bituminous coal)											3	14,137	3	14,137
Utah	1	576,187	4	1,646,238	5	668,498	3	253,279	14	331,601	34	99,783	61	3,575,586
Virginia	9	6,634,730	17	5,084,346	17	2,455,383	8	619,677	16	391,516	61	162,423	128	15,348,075
Washington			2	483,477	4	601,058	2	138,278	15	341,579	25	85,960	48	1,650,352
West Virginia	74	60,687,363	134	40,922,871	117	16,512,680	67	5,230,671	93	2,224,836	258	859,200	743	126,437,621
Wyoming	2	1,116,920	10	3,424,866	6	741,635	2	140,916	9	263,335	33	120,370	62	5,808,042
Total	247	210,699,173	389	122,568,118	[1] 432	[1] 61,810,430	[1] 371	[1] 26,895,655	1,157	26,609,596	[1] 3,728	[1] 12,188,528	6,324	460,771,500

[1] In Alaska, 1 mine that should be included in Class 2 and 1 mine that should be included in Class 5 are included in Class 3 to avoid disclosure of individual operations.

AVERAGE VALUE

TABLE 18.—*Trend of average value in the United States of bituminous coal and lignite, per net ton, f. o. b. mines, 1929–40* [1]

Year	Bituminous coal [2] (subject to regulation under 1937 Act)	Lignite [3]	Total
Average value per ton, less selling cost (Bureau of Mines series):			
1929	$1.782	$1.548	$1.781
1930	1.702	1.556	1.701
1931	1.542	1.410	1.541
1932	1 313	1.313	1.313
1933	1.337	1.188	1.336
1934	1.751	1.387	1.749
1935	1.772	1.120	1.767
1936	1.761	1.061	1.756
Average gross realization, including selling cost (Bituminous Coal Division series):			
1936	1.831	[4] 1.061	1.826
1937	1.946	[4] 1.080	1.939
1938	1.955	[4] 1.071	1.947
1939 [5]	1.850	1.158	1.845
1940	1.913	[4] 1.156	1.908

[1] For explanation see Minerals Yearbook, Review of 1940, pp. 778–779
[2] Includes all coal produced other than Pennsylvania anthracite and the lignite included in the second column.
[3] North Dakota, South Dakota, and the lignite counties of Montana and Texas.
[4] Figures of Bureau of Mines, excluding selling cost as before. Data on sales realization were not collected from lignite mines by the Bituminous Coal Division.
[5] Producers were asked to exclude selling cost in reporting value, but a number of them included such costs.

LABOR STATISTICS

TABLE 19.—*Number of bituminous coal and lignite mines in the United States in 1940, having established working shift of certain length, and number of men employed therein*

State	7 hours		8 hours		9 hours		All others [1]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama	255	23, 210	8	157	------	------	5	109	268	23, 476
Alaska	------	------	3	98	------	------	------	------	3	98
Arizona, Idaho, and Oregon	3	16	4	30	------	------	------	------	7	46
Arkansas	74	2, 540	6	1, 310	------	------	1	25	81	3, 875
Colorado	170	7, 068	27	417	------	------	19	351	216	7, 836
Georgia	------	------	3	130	------	------	------	------	3	130
Illinois	415	31, 973	75	1, 135	1	3	57	3, 047	548	36, 158
Indiana	151	6, 276	48	388	1	3	77	2, 988	277	9, 655
Iowa	211	5, 462	50	602	3	15	12	142	276	6, 221
Kansas	45	1, 753	35	465	1	7	12	589	93	2, 814
Kentucky: Eastern	316	42, 186	96	2, 096	1	4	14	1, 093	427	45, 379
Western	140	8, 737	51	476	------	------	13	204	204	9, 417
Total Kentucky	456	50, 923	147	2, 572	1	4	27	1, 297	631	54, 796
Maryland	87	2, 208	7	131	------	------	------	------	94	2, 339
Michigan	10	870	------	------	------	------	------	------	10	870
Missouri	99	2, 611	77	1, 112	6	55	17	444	199	4, 222
Montana: Bituminous coal	40	1, 176	18	147	------	------	1	4	59	1, 327
Lignite [2]	3	29	10	26	------	------	9	29	22	84
Total Montana	43	1, 205	28	173	------	------	10	33	81	1, 411
New Mexico	30	1, 862	7	70	------	------	3	26	40	1, 958
North Dakota (lignite) [2]	11	286	92	602	4	102	57	387	164	1, 377
Ohio	453	19, 243	128	1, 193	3	61	40	677	624	21, 174
Oklahoma	75	1, 631	20	213	3	19	6	185	104	2, 048
Pennsylvania	1, 154	109, 765	145	1, 651	2	16	113	6, 988	1, 414	118, 420
South Dakota (lignite) [2]	------	------	8	48	------	------	6	15	14	63
Tennessee	100	7, 541	20	707	------	------	4	318	124	8, 566
Texas: Bituminous coal	------	------	2	55	------	------	1	26	3	81
Lignite [2]	------	------	4	60	([3])	([3])	[3] 4	[3] 486	8	546
Total Texas	------	------	6	115	([3])	([3])	[3] 5	[3] 512	11	627
Utah	37	2, 413	20	163	------	------	4	14	61	2, 590
Virginia	102	16, 534	20	439	1	12	5	35	128	17, 020
Washington	48	2, 325	------	------	------	------	------	------	48	2, 325
West Virginia	660	103, 082	56	448	3	29	24	1, 176	743	104, 735
Wyoming	45	4, 140	13	41	1	5	3	39	62	4, 225
Total United States	4, 734	404, 937	1, 053	14, 410	[3] 30	[3] 331	[3] 507	[3] 19, 397	6, 324	439, 075

[1] Includes mines where the day was more than 9 or less than 7 hours or was irregular.
[2] Lignite figures compiled by Bureau of Mines.
[3] Mines and men working "9 hours" included under "All others" for Texas lignite.

TABLE 20.—*Strikes, suspensions, and lock-outs in bituminous coal and lignite mines in the United States, 1939–40, by States*

State	1939					1940				
	Number of men employed [1]	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account of strike		Number of men employed	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account of strike	
				Per man employed	Per man on strike				Per man employed	Per man on strike
Alabama	20,884	14,229	647,608	31	46	23,476	1,630	7,434	(2)	5
Alaska	88					98				
Arizona, Georgia, Idaho, and Oregon	157					176				
Arkansas	4,004	670	5,710	1	9	3,875	89	371	(2)	4
Colorado	8,161	2,617	30,429	4	12	7,836	65	65	(2)	1
Illinois	35,894	16,209	391,902	11	24	36,158	3,373	25,381	1	8
Indiana	9,766	3,293	29,982	3	9	9,655	955	1,819	(2)	2
Iowa	6,251	4,024	140,612	22	35	6,221	400	3,796	1	9
Kansas	2,858	1,250	24,553	9	20	2,814				
Kentucky	50,641	38,169	1,561,624	31	41	54,796	5,167	45,991	1	9
Maryland	2,351	2,000	74,993	32	37	2,339				
Michigan	1,154	392	1,832	2	5	870	306	918	1	3
Missouri	4,493	1,957	63,962	14	33	4,222	283	14,772	3	52
Montana: Bituminous coal	1,383	781	10,319	7	13	1,327				
Lignite	85					84				
Total Montana	1,468	781	10,319	7	13	1,411				
New Mexico	2,199	1,300	9,303	4	7	1,958				
North Dakota (lignite)	1,214					1,377				
Ohio	21,642	16,159	577,476	27	36	21,174	823	8,786	(2)	11
Oklahoma	2,032	635	9,343	5	15	2,048	70	927	(2)	13
Pennsylvania	110,346	78,859	2,840,132	26	36	118,420	15,231	119,170	1	8
South Dakota (lignite)	31					63				
Tennessee	7,925	6,410	248,046	31	39	8,566	1,216	27,994	3	23
Texas: Bituminous coal	236					81				
Lignite	559					546				
Total Texas	795					627				
Utah	2,544	1,240	13,521	5	11	2,590	86	747	(2)	9
Virginia	15,625	11,621	459,911	29	40	17,020	493	1,533	(2)	3
Washington	2,275	875	12,445	5	14	2,325				
West Virginia	103,233	88,713	3,446,965	33	39	104,735	5,140	21,211	(2)	4
Wyoming	3,757	3,394	29,412	8	9	4,225	23	23	(2)	1
Total United States	421,788	294,797	10,630,080	25	36	439,075	35,350	280,938	1	8

[1] Average number of wage earners and working proprietors on active days (excluding shut-down periods).

[2] One-half day or less.

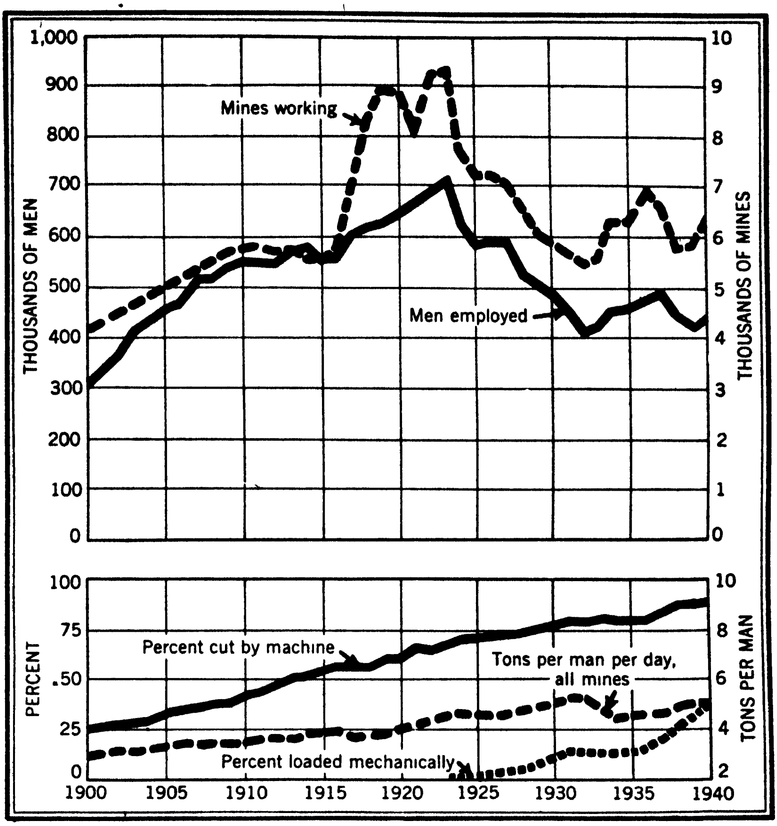

FIGURE 7.—Trends of employment, mechanization, and output per man at bituminous coal and lignite mines in the United States, 1900–1940.

SHIPMENTS BY INDIVIDUAL RAILROADS AND WATERWAYS

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1939–40, as reported by mine operators, in net tons*[1]

Route	State	1939		1940	
		By State	Total for route	By State	Total for route
RAILROADS					
Alabama Central	Alabama	2, 470	2, 470	10, 561	10, 561
Alabama Great Southern	do	189, 790	189, 790	233, 264	233, 264
Alaska	Alaska	143, 549	143, 549	170, 174	170, 174
Algers, Winslow & Western	Indiana	2, 390, 705	2, 390, 705	2, 618, 889	2, 618, 889
Alton	Illinois	760, 639	800, 21	940, 844	971, 387
	Missouri	39, 571		30, 543	
Arkansas Western	Arkansas	---	---	29, 967	29, 967
Artemus-Jellico	Kentucky	471, 456	471, 45	463, 128	463, 128
Atchison, Topeka & Santa Fe	Colorado	164, 127	1, 978, 33	214, 342	1, 846, 520
	Illinois	596, 479		618, 654	
	Kansas	348, 427		298, 497	
	Missouri	31, 939		18, 869	
	New Mexico	837, 359		696, 158	
Baltimore & Ohio	Illinois	88, 920	23, 654, 36	93, 322	26, 952, 507
	Indiana	545, 282		497, 031	
	Maryland	130, 958		93, 311	
	Ohio	2, 062, 708		2, 325, 884	
	Pennsylvania	8, 546, 206		9, 869, 598	
	West Virginia	12, 280, 290		14, 073, 361	

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1939–40, as reported by mine operators, in net tons*—Continued

Route	State	1939		1940	
		By State	Total for route	By State	Total for route
RAILROADS—continued					
Bessemer & Lake Erie	Pennsylvania	2,868,543	2,868,543	3,747,134	3,747,134
Bevier & Southern	Missouri	400,220	400,220	379,574	379,574
Birmingham Southern	Alabama	4,616	4,616	242	242
Buffalo Creek & Gauley	West Virginia	761,500	761,500	722,448	722,448
Cambria & Indiana	Pennsylvania	3,904,830	3,904,830	4,125,884	4,125,884
Campbell's Creek	West Virginia	920,157	920,157	1,105,101	1,105,101
Carbon County	Utah	345,267	345,267	390,958	390,958
Caseyville	Illinois	164,004	164,004	40,579	40,579
Central of Georgia	Alabama	712,490	735,196	782,666	817,748
	Georgia	22,706		35,082	
Chesapeake & Ohio	Kentucky	6,855,203	42,165,721	7,773,799	48,190,979
	Ohio	448,340		476,927	
	West Virginia	34,862,178		39,940,253	
Cheswick & Harmar	Pennsylvania	719,178	719,178	1,018,327	1,018,327
Chicago & Eastern Illinois	Illinois	1,247,615	2,795,258	1,317,815	2,796,692
	Indiana	1,547,643		1,478,877	
Chicago & Illinois Midland	Illinois	4,247,887	4,247,887	5,160,343	5,160,343
Chicago & North Western	do	2,220,202	2,242,541	2,468,572	2,489,822
	Iowa	3,599			
	Wyoming	18,740		21,250	
Chicago, Attica & Southern	Indiana	294	294	10,750	10,750
Chicago, Burlington & Quincy	Colorado	309,817	7,716,513	373,023	7,934,404
	Illinois	6,571,994		6,643,929	
	Iowa	133,598		166,649	
	Missouri	61,879		49,394	
	Wyoming	639,225		701,409	
Chicago Great Western	Iowa	3,753	3,753	2,731	2,731
Chicago, Indianapolis & Louisville	Indiana	1,249,310	1,249,310	1,133,912	1,133.912
Chicago, Milwaukee, St. Paul & Pacific.	Illinois		5,280,995	11,362	6,087,429
	Indiana	4,024,619		4,745,612	
	Iowa	497,451		520,978	
	Missouri	1,604		2,568	
	Montana (bituminous coal).	698,560		738,589	
	North Dakota (lignite). South Dakota (lignite).	51,316		61,007	
	Washington	7,445		7,313	
Chicago, Rock Island & Pacific	Arkansas	3,512	1,299,472	7,668	1,239,729
	Illinois	681,442		702,370	
	Iowa	351,356		309,305	
	Missouri	175.681		113,730	
	Oklahoma	87,481		106,656	
Chicago, Springfield & St. Louis	Illinois	159.109	159,109	163,061	163,061
Cleveland, Cincinnati, Chicago & St. Louis.	do	4,050,403	4,871,151	4,375,277	5,431,327
	Indiana	820,748		1,056,050	
Clinchfield	Kentucky	102,734	2,169,848	77,322	2,300,999
	Virginia	2,067,114		2,223,677	
Colorado & Southeastern	Colorado	93,945	93,945	102,080	102,080
Colorado & Southern	do	584,828	584,828	524,894	524,894
Colorado & Wyoming	do	488,618	488,618	664,699	664,699
Conemaugh & Black Lick	Pennsylvania	36,625	36,625	52,159	52,159
Crystal River & San Juan	Colorado	482	482	341	341
Cumberland & Pennsylvania	Maryland	496,648	496,648	567,243	567,243
Dardanelle & Russellville	Arkansas	39,781	39,781	52,301	52,301
Denver & Intermountain	Colorado	111,916	111,916	105,054	105,054
Denver & Rio Grande Western	do	999,986	2,690,008	1,207,527	2,984,869
	New Mexico	4,737		24,833	
	Utah	1,685,285		1,752,509	
Denver & Salt Lake	Colorado	698,342	698,342	870,003	870,003
Des Moines & Central Iowa	Iowa	107,983	107,983	92,992	92,992
Detroit, Toledo & Ironton	Ohio	12,495	12,495	14,486	14,486
East Broad Top Railroad & Coal Company.	Pennsylvania	508,525	508,525	536,841	536,841
Eastern Railway & Lumber Company.	Washington			270	270
Erie	Ohio	235	1,104,645		1,142,787
	Pennsylvania	1,104,410		1,142,787	
Evansville & Ohio Valley	Indiana	8,177	8,177	7,707	7,707
Evansville, Suburban & Newburgh	do	167,889	167,889	159,957	159,957
Fort Dodge, Des Moines & Southern.	Iowa			7,857	7,857

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1939–40, as reported by mine operators, in net tons*—Continued

Route	State	1939 By State	1939 Total for route	1940 By State	1940 Total for route
RAILROADS—continued					
Fort Smith & Van Buren	Oklahoma	----------	----------	158,663	158,663
Fort Smith & Western	do	112,876	112,876	5,728	5,728
Fort Smith, Subiaco & Rock Island	Arkansas	9,089	9,089	23,183	23,183
Galesburg & Great Eastern	Illinois	592,203	592,203	535,363	535,363
Grand Trunk	Michigan	3,425	3,425	2,006	2,006
Great Northern	Montana (bituminous coal).	414,173	948,472	424,994	908,161
	Montana (lignite).	343,976		333,497	
	North Dakota (lignite).				
	Washington	190,823		149,670	
Gulf, Mobile & Ohio	Alabama	(3)	(3)	75,807	588,808
	Illinois	(3)		513,001	
Harriman & Northeastern	Tennessee	187,309	187,309	191,739	191,739
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	120,285	120,285	111,720	111,720
Illinois Central	Alabama	254,185	12,809,663	310,441	13,997,171
	Illinois	7,860,911		9,094,636	
	Indiana	107,662		99,705	
	Kentucky	4,586,905		4,492,389	
Illinois Terminal	Illinois	521,727	521,727	334,308	334,308
Indiana	Indiana	236,215	236,215	503,746	503,746
International-Great Northern [3]	Texas (lignite)	[3] 793,647	[3] 793,647	[3] 592,720	[3] 592,720
Interstate	Kentucky	61,755	1,943,163	46,337	2,062,183
	Virginia	1,881,408		2,015,846	
Iowa Southern Utilities Company	Iowa	101,578	101,578	105,730	105,730
Johnstown & Stony Creek	Pennsylvania	89,178	89,178	131,389	131,389
Joplin-Pittsburg	Kansas	260,496	260,496	249,962	249,962
Kanawha Central	West Virginia	190,948	190,948	245,098	245,098
Kanawha, Glen Jean & Eastern	do	298,104	298,104	407,559	407,559
Kansas City Southern	Arkansas	16,296	555,243	----------	781,092
	Kansas	13,583		720,932	
	Missouri	498,818		----------	
	Oklahoma	26,546		60,160	
Kansas, Oklahoma & Gulf	do	8,185	8,185	17,809	17,809
Kelly's Creek & Northwestern	West Virginia	1,122,373	1,122,373	1,407,993	1,407,993
Kentucky & Tennessee	Kentucky	798,649	798,649	802,385	802,385
Lake Erie, Franklin & Clarion	Pennsylvania	234,454	234,454	599,804	599,804
Laramie, North Park & Western	Colorado	10,121	10,121	10,308	10,308
Ligonier Valley	Pennsylvania	181,279	181,279	156,730	156,730
Litchfield & Madison	Illinois	630,352	630,352	671,614	671,614
Louisville & Nashville	Alabama	1,946,901	25,432,955	2,513,734	30,708,377
	Illinois	6,992		400	
	Kentucky	22,509,083		26,945,403	
	Tennessee	714,288		844,008	
	Virginia	255,691		404,832	
Mary Lee	Alabama	917,342	917,342	1,218,648	1,218,648
Michigan Central	Michigan	4,147	4,147	9,274	9,274
Midland Valley	Arkansas	257,870	350,797	324,261	417,827
	Oklahoma	92,927		93,566	
Minneapolis & St. Louis	Illinois	515,235	604,208	831,596	936,812
	Iowa	88,973		105,216	
Minneapolis, St. Paul & Sault Ste. Marie.	North Dakota (lignite).	554,996	554,996	572,385	572,385
Missouri-Illinois	Illinois	15,052	15,052	19,881	19,881
Missouri-Kansas-Texas	Kansas	301,004	521,119	303,359	539,123
	Missouri	68,523		38,942	
	Oklahoma	151,592		196,822	
	Texas (lignite)	(3)		(3)	
Missouri Pacific	Arkansas	644,733	5,994,143	732,420	6,456,280
	Illinois	4,271,355		4,439,187	
	Kansas	770,061		893,649	
	Missouri	294,067		346,409	
	Oklahoma	13,927		44,615	
Mobile & Ohio	Alabama	91,472	609,781	(4)	(4)
	Illinois	518,309			
Monessen Southwestern	Pennsylvania	----------	----------	15,349	15,349
Monongahela	do	2,492,177	10,032,376	3,196,701	11,981,379
	West Virginia	7,540,199		8,784,678	
Montana	Arkansas	6,000	6,000	1,731	1,731
Montana, Wyoming & Southern	Montana (bituminous coal).	324,013	324,013	350,226	350,226

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1939–40, as reported by mine operators, in net tons*—Continued

Route	State	1939 By State	1939 Total for route	1940 By State	1940 Total for route
RAILROADS—continued					
Montour	Pennsylvania	4,518,626	4,518,626	5,216,812	5,216,812
Moorhead & North Fork	Kentucky			1,28[illegible]	1,280
Nashville, Chattanooga & St. Louis	Alabama	1,584	807,340	94	876,165
	Tennessee	805,756		876,071	
New York Central (includes coal shipped over Kanawha & Michigan, Kelly's Creek, Toledo & Ohio Central, and Zanesville & Western).	Ohio	5,012,462	9,604,992	5,506,329	11,045,117
	Pennsylvania	3,776,712		4,527,233	
	West Virginia	815,818		1,011,555	
Nicholas, Fayette & Greenbrier	do	1,419,581	1,419,581	1,908,453	1,908,453
Norfolk & Western	Kentucky	3,928,761	37,632,985	4,540,674	44,915,566
	Virginia	7,392,424		8,546,351	
	West Virginia	26,311,800		31,828,541	
Northern Alabama	Alabama	245,186	245,186	97,189	97,189
Northern Pacific	Montana (bituminous coal).	1,159,854	2,578,775	1,124,827	2,595,141
	North Dakota (lignite).	604,757		642,844	
	Washington	814,164		827,470	
Oneida & Western	Tennessee	43,615	43,615	48,882	48,882
Pacific Coast	Washington	211,765	211,765	207,523	207,523
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis).	Illinois	238,745	33,953,514	183,770	40,985,701
	Indiana	1,980,769		2,463,347	
	Ohio	3,306,223		3,942,698	
	Pennsylvania	27,853,229		33,647,863	
	West Virginia	574,548		748,023	
Peoria & Pekin Union	Illinois	2,579	2,579		
Peoria Terminal	do	828,981	828,981	425,733	425,733
Pere Marquette	Michigan	114,643	114,643	91,802	91,802
Pittsburg & Shawmut	Pennsylvania	832,642	832,642	1,234,952	1,234,952
Pittsburg County	Oklahoma	7,038	7,038	11,297	11,297
Pittsburgh & Lake Erie	Pennsylvania	3,063,535	3,063,535	3,451,460	3,451,460
Pittsburgh & West Virginia	Ohio	482,273	1,913,773	535,630	1,939,553
	Pennsylvania	1,378,437		1,270,849	
	West Virginia	53,063		133,074	
Pittsburgh, Lisbon & Western	Pennsylvania	3,858	3,858	4,053	4,053
Pittsburgh, Shawmut & Northern	do	471,370	471,370	676,513	676,513
Preston	West Virginia			212,306	212,306
Quincy, Omaha & Kansas City	Missouri	14,968	14,968		
Rio Grande & Eagle Pass	Texas (bituminous coal).	8,259	8,259		
Rio Grande Southern	Colorado	9,387	9,387	7,371	7,371
Rockdale, Sandow & Southern	Texas (lignite)	(3)	(3)	(3)	(3)
St. Louis & O'Fallon	Illinois	361,027	361,027	334,249	334,249
St. Louis-San Francisco	Alabama	881,813	2,628,324	1,148,283	3,245,225
	Arkansas	116,246		203,157	
	Kansas	712,798		757,357	
	Missouri	369,019		413,784	
	Oklahoma	548,448		722,644	
St. Louis Southwestern of Texas	Texas (lignite)	(3)	(3)	(3)	(3)
Seaboard Air Line	Alabama	194,222	194,222	68,387	68,387
Southern	do	1,544,969	7,157,312	2,199,869	8,380,110
	Illinois	353		2,435	
	Indiana	1,297,105		1,247,418	
	Kentucky	998,355		1,158,336	
	Tennessee	2,150,227		2,543,247	
	Virginia	1,66,303		[illegible],228,805	
Southern Pacific	New Mexico	215,875	215,875	227,875	227,875
Springfield Terminal	Illinois	403,305	403,305	352,074	352,074
Susquehanna & New York	Pennsylvania	10,231	10,231	7,492	7,492
Tennessee	Tennessee	649,669	649,669	730,424	730,424
Tennessee Central	do	229,483	229,483	278,375	278,375
Tennessee Coal, Iron & Railroad Company	Alabama	2,837,723	2,837,723	3,647,982	3,647,982
Terminal Railroad Association of St. Louis	Illinois	13,145	13,145	1,291	1,291
Texas & Pacific	Texas (bituminous coal).	1,295	1,295	8,530	8,[illegible]
Texas Short Line	Texas (lignite)	(3)	(3)	(3)	(3)
Thomas & Sayreton	Alabama	665,039	665,039	896,356	896,356
Toledo, Peoria & Western	Illinois	45,889	45,889	71,745	71,745
Union	Pennsylvania	117,507	117,507	110,086	110,086

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1939–40, as reported by mine operators, in net tons*—Continued

Route	State	1939		1940	
		By State	Total for route	By State	Total for route
RAILROADS—continued					
Union Pacific	Colorado	608,096	4,994,414	568,596	5,385,259
	Kansas	5,274		2,700	
	Utah	3,712		27,839	
	Washington	28,544		26,846	
	Wyoming	4,348,788		4,759,278	
Unity	Pennsylvania	664,921	664,921	651,017	651,017
Utah	Utah	864,205	864,205	941,123	941,123
Virginian	Virginia	142,747	10,726,621	163,223	12,644,024
	West Virginia	10,583,874		12,480,801	
Wabash	Illinois	1,091,818	1,522,709	1,169,291	1,649,034
	Iowa	120,563		112,940	
	Missouri	310,328		366,803	
Western Allegheny	Pennsylvania	53,820	53,820	87,183	87,183
Western Maryland	Maryland	560,631	4,399,078	516,024	4,320,808
	Pennsylvania	406,388		401,141	
	West Virginia	3,432,059		3,403,643	
West Virginia Northern	do	81,012	81,012	80,035	80,035
West Virginia Pulp & Paper Company.	do	16,828	16,828	9,975	9,975
Wheeling & Lake Erie	Ohio	3,391,614	3,391,614	3,931,197	3,931,197
Winfield	Pennsylvania	3,922	3,922	3,879	3,879
Winifrede	West Virginia	70,785	70,785	71,564	71,564
W. M. Ritter Lumber Company	Virginia	4,553	4,553		
Woodward Iron Company	Alabama	635,466	635,466	996,137	996,137
Youngstown & Suburban	Ohio	9,106	9,106		
Total railroad shipments		331,189,620	331,189,620	380,387,674	380,387,674
WATERWAYS					
Allegheny River	Pennsylvania	1,023,608	1,023,608	1,060,382	1,060,382
Black Warrior River	Alabama	84,462	84,462	52,903	52,903
Cheat River	Pennsylvania			33,282	33,282
Green River	Kentucky	290	290	471	471
Illinois River	Illinois	257,407	257,407	288,659	288,659
Kanawha River	West Virginia	2,098,782	2,098,782	1,971,093	1,971,093
Monongahela River	Pennsylvania	16,927,030	17,242,657	24,236,365	24,624,237
	West Virginia	315,627		387,872	
Muskingum River	Ohio	652,753	652,753	778,092	778,092
Ohio River	Kentucky	207,669	867,424	199,959	683,939
	Ohio	1,872		4,233	
	Pennsylvania	2,816		2,000	
	West Virginia	655,067		477,747	
Tennessee River	Alabama	782	782		
Youghiogheny River	Pennsylvania	1,199	1,199		
Total waterway shipments		22,229,364	22,229,364	29,493,058	29,493,058
Total loaded at mines for shipment by railroads and waterways		353,418,984	353,418,984	409,880,732	409,880,732
Shipped by truck or wagon		29,533,824	29,533,824	35,540,476	35,540,476
Used by mine employees and owners for house coal.		1,901,408	1,901,408	2,035,201	2,035,201
Taken by locomotive tenders at tipple.		826,556	826,556	939,058	939,058
Used at mine for power and heat		2,565,276	2,565,276	2,442,989	2,442,989
Made into beehive coke at mine		2,089,475	2,089,475	4,045,050	4,045,050
Transported from mines to points of use by conveyor, chute, or aerial tramway.		4,317,465	4,317,465	5,887,994	5,887,994
Total production		[5] 394,855,325	[5] 394,855,325	460,771,500	460,771,500

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water. In general, the figures show the quantity of bituminous coal and lignite originated for each railroad and waterway as reported by the mine operators. It must be noted that in 1 year an operator may report coal loaded on a subsidiary railroad and in another year the same operator may report coal loaded on the parent railroad system.

[2] Reported as Mobile & Ohio for 1939.

[3] Texas lignite mines shipping over Missouri-Kansas-Texas, Rockdale, Sandow & Southern, St. Louis Southwestern of Texas, and Texas Short Line have been included with International-Great Northern.

[4] Reported as Gulf, Mobile & Ohio for 1940.

[5] Includes 202,337 tons of coal reported as net changes in stocks at mines, January 1, 1939, to January 1, 1940.

METHODS OF RECOVERY

TABLE 22.—*Bituminous coal and lignite mined by different methods in the United States in 1939, by States*

State	From underground workings							From strip pits		Grand total production (net tons)
	Mined by hand		Shot off the solid		Cut by machines		Total underground (net tons)	Net tons	Percent of grand total	
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground				
Alabama	414,741	3.5	3,007,764	25.1	8,562,559	71.4	11,985,064	61,611	0.5	12,046,675
Alaska			148,417	100.0			148,417			148,417
Arizona, Georgia, Idaho, and Oregon	4,063	10.4	34,958	89.6			39,021			39,021
Arkansas			122,555	10.9	1,004,029	89.1	1,126,584	25,454	2.2	1,152,038
Colorado	(1)	(1)	299,543	(1)	4,198,346	(1)	(1)	(1)	(1)	5,923,210
Illinois	542,354	1.6	2,187,568	6.3	31,964,233	92.1	34,694,155	12,088,536	25.8	46,782,691
Indiana	102,950	1.3	597,660	7.4	7,344,792	91.3	8,045,402	8,897,370	52.5	16,942,772
Iowa	450,186	19.0	975,117	41.3	936,578	39.7	2,361,881	585,676	19.9	2,947,557
Kansas	70,375	10.1	400,605	57.6	225,134	32.3	696,114	1,978,577	74.0	2,674,691
Kentucky	1,346,638	3.2	930,604	2.3	39,486,184	94.5	41,763,426	793,142	1.9	42,556,568
Maryland	757,876	52.5			684,852	47.5	1,442,728			1,442,728
Michigan					456,754	100.0	456,754			456,754
Missouri	226,985	22.7	68,605	6.9	704,405	70.4	999,995	2,273,555	69.5	3,273,550
Montana (bituminous coal)	(1)	(1)			1,530,528	(1)	(1)	(1)	(1)	2,756,036
Montana, South Dakota, and Texas (lignite)	[2] 91,185	[2] 11.0	738,667	89.0	(2)	(2)	829,852	75,701	8.4	905,553
New Mexico	415,857	33.8	440,628	35.8	373,575	30.4	1,230,060			1,230,060
North Dakota (lignite)	91,184	12.5	119,921	16.5	517,442	71.0	728,547	1,343,946	64.8	2,072,493
Ohio	95,288	.6	474,301	2.9	15,549,061	96.5	16,118,650	4,170,903	20.6	20,289,553
Oklahoma	6,309	.9	108,520	15.8	572,337	83.3	687,166	500,396	42.1	1,187,562
Pennsylvania	13,509,560	15.1	2,864,907	3.2	73,244,807	81.7	89,619,274	2,964,839	3.2	92,584,113
Tennessee	(1)	(1)	462,570	(1)	4,214,151	(1)	(1)	(1)	(1)	5,185,481
Texas (bituminous coal)	16,259	100.0					16,259			16,259
Utah	(1)	(1)	190,332	(1)	3,083,764	(1)	(1)	(1)	(1)	3,284,904
Virginia	106,886	.8	945,211	7.0	12,478,877	92.2	13,530,974			13,530,974
Washington	(1)	(1)	692,008	(1)	708,399	(1)	(1)	(1)	(1)	1,690,442
West Virginia	4,806,405	4.4	957,271	.9	102,005,341	94.7	107,769,017	592,917	.5	108,361,934
Wyoming	936,298	18.0	135,518	2.6	4,123,246	79.4	5,195,062	178,227	3.3	5,373,289
Total	[2] 26,260,098	[2] 7.4	16,903,250	4.7	[2] 313,969,394	[2] 87.9	357,132,742	37,722,583	9.6	394,855,325

[1] Not shown separately to avoid disclosure of individual operations.
[2] Small quantity of lignite "Cut by machines" in Montana included in figures for "Mined by hand."

TABLE 23.—*Bituminous coal and lignite mined by different methods in the United States in 1940, by States*

State	From underground workings							From strip pits		Grand total production (net tons)
	Mined by hand		Shot off the solid		Cut by machines		Total underground (net tons)	Net tons	Percent of grand total	
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground				
Alabama	1,359,422	8.9	2,168,327	14.2	11,720,773	76.9	15,248,522	75,641	0.5	15,324,163
Alaska			173,844	100.0			173,844			173,844
Arizona, Idaho, and Oregon	14,858	87.9	2,044	12.1			16,902			16,902
Arkansas	24,931	1.7	117,032	8.2	1,285,840	90.1	1,427,803	25,808	1.8	1,453,611
Colorado	1,483,641	22.6	437,327	6.6	4,655,314	70.8	6,576,282	12,460	.2	6,588,742
Georgia			42,307	100.0			42,307			42,307
Illinois	327,979	.9	2,617,459	7.0	34,589,737	92.1	37,535,175	13,075,255	25.8	50,610,430
Indiana	26,270	.3	549,127	6.2	8,254,097	93.5	8,829,494	10,039,078	53.2	18,868,572
Iowa	282,315	11.3	1,212,723	48.4	1,010,227	40.3	2,505,265	725,912	22.5	3,231,177
Kansas	61,128	7.4	441,302	53.6	320,818	39.0	823,248	2,755,704	77.0	3,578,952
Kentucky	1,936,171	4.0	848,639	1.8	45,493,619	94.2	48,278,429	862,475	1.8	49,140,904
Maryland	803,929	53.5			699,504	46.5	1,503,433			1,503,433
Michigan					410,169	100.0	410,169			410,169
Missouri	250,143	22.4	82,698	7.4	783,054	70.2	1,115,895	1,980,846	64.0	3,096,741
Montana (bituminous coal)	9,713	.6	57,589	3.4	1,624,702	96.0	1,692,004	1,126,932	40.0	2,818,936
Montana and Texas (lignite) [1]	53,622	8.8	[2] 543,180	89.1	12,964	2.1	609,766	44,916	6.9	654,682
New Mexico	568,982	51.2	184,734	16.6	356,899	32.2	1,110,615			1,110,615
North Dakota (lignite) [1]	111,044	13.6	[2] 144,392	17.8	557,408	68.6	812,844	1,405,590	63.4	2,218,434
Ohio	164,195	.9	214,013	1.2	17,345,747	97.9	17,723,955	5,047,597	22.2	22,771,552
Oklahoma	1,004	.1	195,182	19.1	828,154	80.8	1,024,340	621,641	37.8	1,645,981
Pennsylvania	14,425,666	12.8	5,084,556	4.5	92,862,615	82.7	112,372,837	4,230,162	3.6	116,602,999
South Dakota (lignite) [1]	[2] 4,283	100.0					4,283	61,802	93.5	66,085
Tennessee	592,422	9.9	619,667	10.3	4,794,713	79.8	6,006,802	1,654	(3)	6,008,456
Texas (bituminous coal)	13,537	95.8			600	4.2	14,137			14,137
Utah	50,727	1.4	143,225	4.0	3,381,634	94.6	3,575,586			3,575,586
Virginia	40,889	.3	1,180,051	7.7	14,120,735	92.0	15,341,675	6,400	(3)	15,348,075
Washington	217,797	13.3	647,920	39.7	768,675	47.0	1,634,392	15,960	1.0	1,650,352
West Virginia	5,960,335	4.8	528,205	.4	119,075,498	94.8	125,564,038	873,583	.7	126,437,621
Wyoming	1,091,971	19.4	264,370	4.7	4,273,781	75.9	5,630,122	177,920	3.1	5,808,042
Total	[2] 29,876,974	7.2	[2] 18,499,913	4.4	369,227,277	88.4	417,604,164	43,167,336	9.4	460,771,500

[1] Lignite figures compiled by Bureau of Mines.
[2] Includes some coal published by Bureau of Mines as "not specified."
[3] Less than 0.05 percent.

TABLE 24.—*Number of coal-cutting machines in bituminous coal and lignite mines, average output per machine, and percent of total product of underground mines cut by machines in the United States, 1939–40, by States*

State	1939							1940				
	Number of coal-cutting machines in use					Average output per machine (net tons)	Percent of total product of underground mines cut by machines	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	Track-mounted		Other types		Total			Permissible	Other	Total		
	Permissible	Other	Permissible	Other								
Alabama	33	4	100	298	435	19,684	71.4	220	279	499	23,489	76.9
Arkansas	2	6	95	63	166	6,048	89.1	93	50	143	8,992	90.1
Colorado	45	40	133	229	447	9,392	(1)	229	208	437	10,653	70.8
Illinois	59	133	225	604	1,021	31,307	92.1	238	673	911	37,969	92.1
Indiana	32	16	94	110	252	29,146	91.3	112	130	242	34,108	93.5
Iowa	6	17	52	28	103	9,093	39.7	41	52	93	10,863	40.3
Kansas	9		11	24	44	5,117	32.3	29	14	43	7,461	39.0
Kentucky	125	198	368	773	1,464	26,971	94.5	394	1,097	1,491	30,512	94.2
Maryland	3	6	28	17	54	12,682	47.5	25	17	42	16,655	46.5
Michigan	22		8	23	53	8,618	100.0	17	26	43	9,539	100.0
Missouri	1		63	27	91	7,741	70.4	51	33	84	9,322	70.2
Montana:												
Bituminous coal	7	4	4	52	67	22,844	(1)	17	47	64	25,386	96.0
Lignite			1		1		(2)	(3)	(3)	(3)	(3)	(3)
New Mexico	4	8	14	35	61	6,124	30.4	26	33	59	6,049	32.2
North Dakota (lignite)			13	8	21	24,640	71.0	[3] 13	[3] 7	[3] 20	[3] 28,519	[3] 66.5
Ohio	38	60	158	562	818	19,009	96.5	264	553	817	21,[illegible]31	97.9
Oklahoma	13	4	51	30	98	5,840	83.3	50	35	85	9,743	80.8
Pennsylvania	313	92	1,642	1,280	3,327	22,015	81.7	2,092	1,069	3,161	29,378	82.7
Tennessee	14	2	56	106	178	23,675	(1)	52	131	183	26,201	79.8
Texas (bituminous coal)								1		1	600	4.2
Utah	33	1	44	44	122	25,277	(1)	80	44	124	27,271	94.6
Virginia	64	30	72	136	302	41,321	92.2	71	224	295	47,867	92.0
Washington	1		43	6	50	14,168	(1)	43	6	49	15,687	47.0
West Virginia	311	339	460	1,652	2,762	36,932	94.7	817	1,953	2,770	42,988	94.8
Wyoming	1	4	43	242	290	14,218	79.4	42	252	294	14,537	75.9
Total	1,136	964	3,778	6,349	12,227	25,678	[2] 87.9	5,017	6,933	11,950	30,898	88.4

[1] Not shown separately to avoid disclosure of individual operations.
[2] Small quantity of lignite "cut by machines" in Montana excluded.
[3] Montana lignite included with North Dakota lignite

STRIPPING OPERATIONS

TABLE 25.—*Stripping operations of all types in the bituminous coal and lignite fields of the United States in 1939, by States and counties*

Returns for mines that recover coal both by stripping and by underground operations do not permit separating number of men engaged in stripping from those engaged in other work. For this reason, figures for men employed represent all persons working at such mines, including those underground. Total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels[1]			Coal produced (net tons)		Average number of wage earners and working proprietors on active days (excluding shut-down periods)				Average number of full days mines were active	Number of man-shifts worked by wage earners and working proprietors on active days (excluding shut-down periods)	Tons of coal produced on active days per man-shift
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface: In strip pits	Surface: All others	Total			
Alabama: Bibb, Blount, Marion, Tuscaloosa, and Walker	6	3		4	61,611	61,611		90	35	125	105	13,103	4.70
Arkansas: Franklin and Sebastian	6	4		1	25,454	46,903	52	45	21	118	116	13,636	3.44
Illinois:													
Adams, Grundy, Henry, Jackson, Knox, Livingston, Peoria, Randolph, Scott, and Will	12	1	22	15	3,925,780	3,925,780		583	374	957	262	250,507	15.67
Fulton	8	2	20	3	3,253,708	3,253,708		267	356	623	233	144,911	22.45
La Salle	7	1	1	7	173,876	173,876		82	39	121	187	22,675	7.67
Perry	5	3	13	4	2,343,305	2,343,305		423	142	565	248	140,153	16.72
St. Clair	4		4	10	805,989	805,989		116	50	166	218	36,184	22.27
Saline	3		2	2	742,388	742,388		100	44	144	246	35,441	20.95
Vermilion	5	1	2	3	154,472	154,472		40	31	71	103	7,318	21.11
Williamson	7	2	2	7	689,018	689,018		150	65	215	171	36,733	18.76
Total Illinois	51	10	66	51	12,088,536	12,088,536		1,761	1,101	2,862	235	673,922	17.94
Indiana:													
Clay	28	5	11	45	1,230,840	1,230,840		503	162	665	192	127,969	9.62
Daviess, Knox, Owen, Parke, Spencer, and Vermillion	9	2	2	15	482,689	482,689		150	65	215	159	34,291	14.08
Fountain	7	1		7	18,872	18,872		51	13	64	96	6,150	3.07
Greene	16	5	6	14	1,523,665	1,523,665		398	235	633	184	116,669	13.06
Pike	11	6	14	9	3,173,940	3,173,940		454	385	839	215	180,136	17.62
Sullivan	7	6	2	7	547,441	547,441		155	82	237	173	40,893	13.39
Vigo	5	2	4	5	905,854	905,854		207	109	316	232	73,456	12.33
Warrick	5		5	10	1,014,069	1,014,069		222	129	351	195	68,426	14.82
Total Indiana	88	27	44	112	8,897,370	8,897,370		2,140	1,180	3,320	195	647,990	13.73

[1] Number of power shovels shown represents equipment in use or available for use as of Jan. 1, 1940.

TABLE 25.—*Stripping operations of all types in the bituminous coal and lignite fields of the United States in 1939, by States and counties*—Continued

State and county	Number of strip pits	Number of power shovels [1]			Coal produced (net tons)		Average number of wage earners and working proprietors on active days (excluding shut-down periods)				Average number of full days mines were active	Number of man-shifts worked by wage earners and working proprietors on active days (excluding shut-down periods)	Tons of coal produced on active days per man-shift
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface: In strip pits	Surface: All others	Total			
Iowa:													
Davis, Greene, Jasper, Monroe, Polk, Van Buren, Warren, and Webster	11	1	2	6	70, 331	70, 331		68	28	96	130	12, 510	5. 62
Mahaska	11	2	1	16	227, 874	227, 874		135	49	184	162	29, 744	7. 66
Marion	9			18	215, 023	215, 023		95	19	114	215	24, 496	8. 78
Wapello	3			7	72, 448	72, 448		24	12	36	198	7, 134	10. 16
Total Iowa	34	3	3	47	585, 676	585, 676		322	108	430	172	73, 884	7. 93
Kansas:													
Bourbon	4	5	2		147, 749	147, 749		70	16	86	173	14, 838	9. 96
Cherokee	7	3	2	4	594, 555	594, 555		122	83	205	257	52, 739	11. 27
Crawford	15	9	13	3	1, 222, 725	1, 222, 725		307	204	511	163	83, 490	14. 65
Labette and Linn	3	2		1	8, 137	8, 137		10	3	13	166	2, 161	3. 77
Osage	4	4		1	5, 411	5, 411		16	4	20	115	2, 299	2. 35
Total Kansas	33	23	17	9	1, 978, 577	1, 978, 577		525	310	835	186	155, 527	12. 72
Kentucky: Christian, Clay, Hopkins, and Whitley	5	1	2	4	793, 142	809, 899	16	93	50	159	197	31, 320	25. 86
Missouri:													
Barton	8	5	2	4	118, 833	118, 833		81	29	110	150	16, 530	7. 19
Bates	6	5	1	2	580, 515	580, 515		113	55	168	201	33, 767	17. 19
Boone	3	1		2	9, 767	9, 767		21	5	26	107	2, 775	3. 52
Callaway	3	2		3	130, 690	130, 690		36	22	58	272	15, 795	8. 27
Chariton, Clark, Dade, Howard, Jasper, Johnson, Lincoln, Macon, Monroe, Morgan, Randolph, and Warren	15	4	3	7	754, 986	754, 986		218	65	283	210	59, 533	12. 68
Henry	9	8	6	1	635, 409	635, 409		148	107	255	222	56, 622	11. 22
Vernon	7	5		3	43, 355	43, 355		55	14	69	101	6, 987	6. 21
Total Missouri	51	30	12	22	2, 273, 555	2, 273, 555		672	297	969	198	192, 009	11. 84
Montana, South Dakota, and Texas: Lignite	7	4		2	75, 701	75, 701		32	20	52	150	7, 769	9. 74
North Dakota: Lignite	30	7	8	16	1, 343, 946	1, 345, 873	5	305	186	496	217	107, 531	12. 52

Ohio														
Belmont, Hocking, Holmes, Muskingum, Perry, and Portage	10	2	1	13	328,066	328,066		82	38	120	223	26,731	12.27
Carroll	7	6		6	155,023	173,620	10	78	19	107	205	21,917	7.92
Columbiana	21	2		18	433,507	436,199	2	92	30	124	240	29,745	14.66
Coshocton	3	2		4	25,246	43,095	11	21	9	41	233	9,572	4.50
Harrison	4	5	1	4	637,861	637,861		81	83	164	218	35,831	17.80
Jackson	3	5		2	48,127	48,127		27	6	33	117	3,864	12.46
Jefferson	12	7	6	11	1,401,596	1,401,596		297	158	455	177	80,326	17.45
Mahoning	6	6	2	7	362,176	362,176		93	17	110	209	22,946	15.78
Stark	10	1		22	443,794	445,255	2	131	27	160	245	39,162	11.37
Tuscarawas	13	4	1	7	271,937	274,611	6	101	31	138	230	31,678	8.67
Vinton	6	2		4	63,570	63,570		47	8	55	179	9,843	6.46
Total Ohio	95	42	11	98	4,170,903	4,214,176	31	1,080	426	1,507	207	311,615	13.52
Oklahoma:													
Craig	3		1	4	8,288	8,288		14	4	18	181	3,253	2.55
Haskell, Muskogee, Okmulgee, Rogers, Sequoyah, Tulsa, and Wagoner	11	11	3	3	492,108	492,108		130	97	227	211	47,871	10.28
Total Oklahoma	14	11	4	7	500,396	500,396		144	101	245	209	51,124	9.79
Pennsylvania:													
Allegheny	15	6		15	378,467	379,019	8	185	50	243	113	27,435	13.82
Armstrong, Cameron, Elk, and Lycoming	5		1	3	49,299	49,299		26	13	39	118	4,595	10.73
Beaver	9	2		28	586,181	586,181		156	91	247	243	59,941	9.78
Butler, Crawford, Lawrence, Mercer, and Venango	7	1	1	12	140,252	149,488	57	74	46	177	101	17,948	8.33
Clarion	5	2		12	265,328	268,071	5	72	18	95	195	18,496	14.49
Clearfield	9	7		6	122,729	156,404	52	110	32	194	163	31,679	4.94
Fayette	16	9		11	469,556	482,083	39	280	53	372	140	52,087	9.26
Jefferson	4	2		4	60,060	65,352	14	36	10	60	117	7,038	9.29
Tioga	4			11	49,663	61,501	16	33	16	65	210	13,651	4.51
Washington	13	5	2	18	772,961	1,018,778	223	209	102	534	195	104,376	9.76
Westmoreland	7	2	3	8	70,343	159,086	91	38	45	174	142	24,667	6.45
Total Pennsylvania	94	36	7	128	2,964,839	3,375,262	505	1,219	476	2,200	165	361,913	9.33
West Virginia:													
Brooke	6		1	11	331,374	331,374		184	53	237	120	28,453	11.65
Hancock and Preston	3			7	261,543	261,543		85	18	103	209	21,486	12.17
Total West Virginia	9		1	18	592,917	592,917		269	71	340	147	49,939	11.87
Wyoming:													
Campbell, Carbon, and Sheridan	4	2	3	1	164,662	174,971	8	41	12	61	228	13,891	12.60
Converse	3	1			13,565	13,565		12	3	15	170	2,544	5.33
Total Wyoming	7	3	3	1	178,227	188,536	8	53	15	76	216	16,435	11.47
Other States [2]	7	2	6	4	1,191,733	1,222,543	28	71	40	139	220	30,511	40.07
Total United States	537	206	184	524	37,722,583	38,257,531	645	8,791	4,487	13,873	197	2,738,228	13.97

[1] Number of power shovels shown represents equipment in use or available for use as of Jan. 1, 1940. [2] Colorado, Montana (bituminous), Tennessee, Utah, and Washington.

TABLE 26.—*Stripping operations of all types in the bituminous coal and lignite fields of the United States in 1940, by States and counties*

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating number of men engaged in stripping from those engaged in other work. For this reason, figures for men employed represent all persons working at such mines, including those underground. Total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface: In strip pits	Surface: All others	Total			
Alabama: Bibb, Blount, Jefferson, Marion, and Walker	7	7	1	3	75,641	81,641	31	94	50	175	104	18,212	4.48
Arkansas: Franklin and Sebastian	4	2			25,808	25,808		58	10	68	171	11,659	2.21
Illinois:													
Adams, Crawford, Edgar, Grundy, Hancock, Henry, Jackson, Knox, Livingston, McDonough, Peoria, Randolph, Schuyler, Scott, and Will	21		20	22	3,933,224	3,933,224		630	498	1,128	229	258,303	15.23
Fulton	8		20	6	3,575,553	3,575,553		268	438	706	222	156,473	22.85
La Salle	7		2	9	207,739	207,739		88	53	141	180	25,439	8.17
Perry	4	2	13	4	2,676,461	2,676,461		365	277	642	223	143,277	18.68
St. Clair	3		5	9	892,346	892,346		108	66	174	218	37,881	23.56
Saline	4		5	4	1,333,420	1,333,420		160	98	258	263	67,948	19.62
Vermilion	4			6	218,526	218,526		41	32	73	125	9,142	23.90
Williamson	3	1		5	237,986	237,986		69	40	109	147	16,072	14.81
Total Illinois	54	3	65	65	13,075,255	13,075,255		1,729	1,502	3,231	221	714,535	18.30
Indiana:													
Clay	31	3	6	46	1,275,038	1,275,038		414	255	669	172	115,062	11.08
Daviess, Knox, Parke, and Spencer	6	2	2	7	289,138	289,138		67	59	126	180	22,741	12.71
Fountain	5			6	52,757	52,757		25	18	43	132	5,667	9.31
Greene	9	5	9	8	1,569,338	1,569,338		222	282	504	200	101,000	15.54
Owen	3			5	25,981	30,992	5	24	18	47	61	2,879	10.76
Pike	15	6	13	17	3,495,567	3,495,567		449	466	915	208	189,924	18.41
Sullivan	8	2	3	11	484,227	484,227		100	106	206	153	31,504	15.37
Vermillion	4		2	3	224,961	224,961		57	42	99	169	16,699	13.47
Vigo	6	2	4	6	1,283,842	1,283,842		116	248	364	212	77,074	16.66
Warrick	9	1	7	12	1,338,229	1,338,229		277	140	417	164	68,506	19.53
Total Indiana	96	21	46	121	10,039,078	10,044,089	5	1,751	1,634	3,390	186	631,056	15.92

Iowa:													
Davis, Greene, Jasper, Monroe, Polk, Van Buren, Warren, and Webster	14		2	13	79,008	79,008		85	41	126	104	13,139	6.01
Mahaska	13		2	19	315,159	315,159		159	63	222	180	39,870	7.90
Marion	13			21	252,095	252,095		97	39	136	228	30,976	8.14
Wapello	4			8	79,650	79,650		29	21	50	192	9,612	8.29
Total Iowa	44		4	61	725,912	725,912		370	164	534	175	93,597	7.76
Kansas													
Bourbon	4	3	2	1	153,234	153,234		37	31	68	192	13,024	11.77
Cherokee	5	3	7	2	499,213	499,213		62	142	204	165	33,636	14.84
Crawford	17	14	15	3	1,381,995	1,381,995		290	264	554	168	92,805	14.89
Labette	4	2		2	16,413	16,413		18	3	21	156	3,284	5.00
Linn and Osage	5	3	2	3	704,849	704,849		67	76	143	239	34,108	20.67
Total Kansas	35	25	26	11	2,755,704	2,755,704		474	516	990	179	176,857	15.58
Kentucky:													
Christian and Hopkins	4	2	4	4	850,187	857,764	7	79	84	170	177	30,145	28.45
Laurel and Whitley	3	2		1	12,288	12,288		21	15	36	99	3,576	3.44
Total Kentucky	7	4	4	5	862,475	870,052	7	100	99	206	164	33,721	25.80
Missouri:													
Barton	8	7	2		182,482	182,482		68	27	95	135	12,824	14.23
Bates	7	5		4	100,033	100,033		74	18	92	113	10,403	9.62
Boone, Clark, Dade, Howard, Jasper, Johnson, Lafayette, Lincoln, Macon, Miller, Monroe, Morgan, Ralls, Randolph, and Saline	18	5	5	15	832,355	832,355		185	109	294	185	54,326	15.32
Callaway	4	3		3	150,136	150,136		37	23	60	267	16,030	9.37
Henry	12	7	6	4	653,146	653,146		209	94	303	213	64,521	10.12
Vernon	7	7		2	62,694	62,694		45	11	56	156	8,728	7.18
Total Missouri	56	34	13	28	1,980,846	1,980,846		618	282	900	185	166,832	11.87
Montana and Texas. Lignite	5	2			44,916	44,916		24	1	25	104	2,599	17.28
North Dakota. Lignite	52	6	6	23	1,405,590	1,405,590		371	144	515	206	105,868	13.28
Ohio:													
Belmont, Gallia, Hocking, Holmes, Lawrence, Portage, and Wayne	10	1		10	184,160	184,864	1	107	28	136	161	21,949	8.42
Carroll	5	2		8	135,481	174,291	27	49	14	90	276	24,840	7.02
Columbiana	12	1	1	24	505,691	505,691		116	18	134	246	33,009	15.32
Coshocton	3	2		2	22,954	46,006	12	14	8	34	222	7,558	6.09
Harrison	5	3	2	8	720,412	720,412		126	59	185	195	36,013	20.00
Jackson	5	1		4	36,029	36,029		38	9	47	97	4,576	7.87
Jefferson	12	5	4	18	1,735,643	1,735,643		282	219	501	199	99,501	17.44
Mahoning	9	7	1	10	306,673	306,673		111	21	132	265	34,965	8.77
Muskingum	3	2		11	64,800	64,800		23	12	35	195	6,819	9.50
Perry	4		1	8	207,595	207,595		40	25	65	225	14,601	14.22

TABLE 26.—*Stripping operations of all types in the bituminous coal and lignite fields of the United States in 1940, by States and counties*—Con.

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface		Total			
								In strip pits	All others				
Ohio—Continued.													
Stark	10			28	717, 638	717, 638		143	79	222	293	65, 022	11. 04
Tuscarawas	21	5	2	24	351, 900	352, 870	1	139	34	174	232	40, 354	8. 74
Vinton	6	3		4	58, 621	58, 621		39	15	54	220	11, 868	4. 94
Total Ohio	105	33	11	159	5, 047, 597	5, 111, 133	41	1, 227	541	1, 809	222	401, 075	12. 74
Oklahoma:													
Coal, Haskell, Muskogee, Rogers, Sequoyah, Tulsa, and Wagoner	11	10	5	4	611, 312	611 312		173	84	257	186	47, 792	12. 79
Craig	3	1		3	10, 329	10, 329		10	4	14	172	2, 404	4. 30
Total Oklahoma	14	11	5	7	621, 641	621, 641		183	88	271	185	50, 196	12. 38
Pennsylvania:													
Allegheny	20	4		24	515, 938	516, 012	1	229	86	316	149	47, 017	10. 98
Armstrong	4			8	203, 775	493, 401	266	77	35	378	212	80, 017	6. 17
Beaver	12	2	2	25	604, 714	604, 714		200	71	271	214	57, 960	10. 43
Butler	4			6	169, 954	169, 954		86	26	112	142	15, 869	10. 71
Cambria, Cameron, Crawford, Elk, Lawrence, Lycoming, McKean, Mercer, Tioga, and Venango	15	5		22	351, 400	355, 892	23	124	58	205	157	32, 245	11. 04
Center	3			4	33, 002	58, 576	12	58	16	86	175	15, 012	3. 90
Clarion	8			19	491, 148	491, 148		153	58	211	170	35, 934	13. 67
Clearfield	13	4		13	222, 221	286, 071	108	155	57	320	139	44, 534	6. 42
Fayette	18	5		18	410, 191	488, 929	147	248	60	455	89	40, 646	12. 03
Jefferson	4	2		5	243, 402	250, 989	16	57	21	94	182	17, 091	14. 69
Somerset	3			5	13, 061	13, 061		34	9	43	45	1, 930	6. 77
Washington	16	5	5	18	833, 588	1, 176, 004	247	165	124	536	218	117, 090	10. 04
Westmoreland	10	2		14	137, 768	139, 742	14	99	41	154	62	9, 486	14. 73
Total Pennsylvania	130	29	7	181	4, 230, 162	5, 044, 493	834	1, 685	662	3, 181	162	514, 831	9. 80
South Dakota: Lignite	8			2	61, 802	61, 802		39	9	48	188	9, 023	6. 85

West Virginia:													
Brooke	6			15	568, 914	568, 914		72	43	115	199	22, 916	24. 83
Hancock, Harrison, and Preston	4			8	304, 669	304, 669		55	28	83	211	17, 486	17. 42
Total West Virginia	10			23	873, 583	873, 583		127	71	198	204	40, 402	21. 62
Wyoming: Campbell, Carbon, Converse, and Sheridan	5	2	2	2	177, 920	177, 920		49	14	63	218	13, 758	12. 93
Other States [1]	6	1	4	6	1, 163, 406	1, 199, 767	40	84	43	167	202	33, 667	35. 64
Total United States	638	180	194	697	43, 167, 336	44, 100, 152	958	8, 963	5, 830	15, 771	191	3, 017, 888	14. 61

[1] Colorado, Montana (bituminous), Tennessee, Virginia, and Washington.

TABLE 27.—*Summary of operations of power strip pits proper in the bituminous coal and lignite fields of the United States in 1939, by States*

State	Number of strip pits	Number of power shovels [1]			Net tons mined by stripping [2]	Average number of wage earners and working proprietors on active days (excluding shut-down periods)	Average number of full days mines were active	Tons of coal produced on active days per man-shift
		Steam	Electric	All others				
Power strip pits proper:								
Alabama	6	3		4	61,611	125	105	4.70
Arkansas	3	3		1	13,171	28	130	3.63
Illinois	45	10	66	51	12,065,935	2,827	236	18.07
Indiana	82	27	44	112	8,889,021	3,302	196	13.77
Iowa	31	3	3	47	572,058	404	173	8.20
Kansas	31	23	17	9	1,974,558	826	187	12.80
Kentucky	3		2	3	776,207	119	219	29.85
Missouri	45	30	12	22	2,245,286	929	200	12.08
North Dakota (lignite)	14	7	8	16	1,308,097	444	227	12.99
Ohio	85	39	11	96	4,104,451	1,398	207	14.21
Oklahoma	13	11	4	7	499,176	243	208	9.85
Pennsylvania	67	24	7	105	2,441,446	1,332	169	10.88
West Virginia	8		1	18	590,359	337	147	11.93
Wyoming	4	3	3		162,123	53	229	13.33
Other States [3]	6	6	6	5	1,245,291	111	216	52.00
Total	443	189	184	496	36,948,790	12,478	202	14.6[illegible]
Horse stripping operations	71				183,888	265	146	4.77
Mines combining stripping and underground methods in same operations [4]	23	17		28	589,905	[5] 1,130	[5] 162	[5] 6.14
Grand total	537	206	184	524	37,722,583	[5] 13,873	[5] 197	[5] 13.97

[1] Number of power shovels shown represents equipment in use or available for use as of Jan. 1, 1940.

[2] Excludes coal produced by underground mining conducted in same operation.

[3] Colorado, Montana (bituminous), South Dakota (lignite), Tennessee, and Texas (lignite).

[4] Includes operations in Arkansas, Kentucky, North Dakota (lignite), Ohio, Pennsylvania, Tennessee, Washington, and Wyoming, in which output was obtained by both methods. In addition to the 589,905 tons produced by stripping, this group of 23 mines obtained 534,948 tons by underground methods—their total production by both methods being 1,124,853 tons.

[5] Includes data on underground mining conducted in same operation.

TABLE 28.—*Summary of operations of power strip pits proper in the bituminous coal and lignite fields of the United States in 1940, by States*

State	Number of strip pits	Number of power shovels: Steam	Electric	All others	Net tons mined by stripping [1]	Number of men employed	Average number of days mines were active	Average tons per man per day
Power strip pits proper:								
Alabama	4	5	1	3	60,266	122	91	5.44
Illinois	51	3	65	65	13,069,265	3,217	222	18.33
Indiana	86	21	46	119	10,020,242	3,356	187	15.96
Iowa	40	-------	4	61	719,529	514	176	7.96
Kansas	34	25	26	11	2,754,504	985	179	15.60
Kentucky	6	3	3	5	853,038	193	164	26.94
Missouri	54	34	13	28	1,972,321	890	185	11.98
North Dakota (lignite)	19	6	6	23	1,355,634	418	225	14.41
Ohio	95	31	11	156	4,947,506	1,690	219	13.36
Oklahoma	14	11	5	7	621,641	271	185	12.38
Pennsylvania	107	21	7	163	3,704,489	1,920	151	12.78
West Virginia	10	-------	-------	23	873,583	198	204	21.62
Wyoming	4	2	2	2	168,360	58	214	13.60
Other States [2]	8	5.	4	6	1,257,715	206	189	32.23
Total	532	167	193	672	42,378,093	14,038	193	15.63
Horse stripping operations	76	-------	-------	-------	164,339	260	148	4.26
Mines combining stripping and underground methods in same operations [3]	30	13	1	25	624,904	[4] 1,473	[4] 182	[4] 5.80
Grand total	638	180	194	697	43,167,336	[4] 15,771	[4] 191	[4] 14.61

[1] Excludes coal produced by underground mining conducted in same operation.
[2] Arkansas, Colorado, Montana (bituminous), South Dakota (lignite), Tennessee, Texas (lignite), and Virginia.
[3] Includes operations in Alabama, Indiana, Kentucky, Ohio, Pennsylvania, and Washington, in which output was obtained by both methods. In addition to the 624,904 tons produced by stripping, this group of 30 mines obtained 932,816 tons by underground methods—their total production by both methods being 1,557,720 tons
[4] Includes data on underground mining conducted in same operation.

POWER DRILLING

TABLE 29.—*Summary of operations of underground bituminous coal and lignite mines in the United States in 1940, where shot holes were power-drilled*

State	Number of mines using power drills		Number of power drills								Production in working places where shot holes were power-drilled (net tons)			Total production from mines using power drills (net tons)		
			Electric				Compressed air									
	In coal and coal and rock	In rock only	In coal only	In coal and rock	In rock only	Total	In coal only	In coal and rock	In rock only	Total	Electric drills	Compressed-air drills	Total	In coal and coal and rock	In rock only	Total
Alabama	45	11	413	255	15	683	4		87	91	8,458,206	70,939	8,529,145	12,502,257	963,838	13,466,095
Arkansas	11	25	21	1	22	44	2	1	48	51	(1)	(1)	284,736	389,476	753,376	1,142,852
Colorado	45	4	183	49	5	237			20	20	2,735,014		2,735,014	3,457,224	1,148,706	4,605,930
Illinois	109	(1)	884	75	10	969	11		24	35	30,998,780	177,751	31,176,531	(1)	(1)	32,946,429
Indiana	29		149	31	3	183			5	5	7,459,670		7,459,670	7,470,178		7,470,178
Iowa	4		10			10					143,049		143,049	334,268		334,268
Kansas	3		1	3		4					30,800		30,800	30,800		30,800
Kentucky	162	28	774	35	53	862	11		114	125	24,134,969	408,761	24,543,730	34,909,791	5,294,433	40,204,224
Maryland	4	3	9	2	7	18		5		5	(1)	(1)	323,182	369,710	227,951	597,661
Michigan	4	(1)	5	6	4	15			1	1	68,569		68,569	(1)	(1)	326,632
Montana (bituminous coal)	8		45		1	46			1	1	1,540,861		1,540,861	1,548,661		1,548,661
North Dakota (lignite)	7		10			10					387,327		387,327	402,951		402,951
Ohio	35	8	155	80	16	251	1		6	7	(1)	(1)	8,782,661	12,255,946	533,159	12,789,105
Oklahoma	6	(1)	3	2	3	8	10	2	1	13	(1)	(1)	64,056	(1)	(1)	201,369
Pennsylvania	124	67	812	206	163	1,181	42	59	394	495	37,965,496	5,141,456	43,106,952	58,152,787	23,061,316	81,214,103
Tennessee	13	6	47	3	3	53		1	19	20	(1)	(1)	1,051,403	2,014,183	1,409,464	3,423,647
Utah	20		106	3		109			13	13	3,271,097		3,271,097	3,286,766		3,286,766
Virginia	27	15	131	3	11	145	1	1	48	50	(1)	(1)	5,896,098	7,809,602	3,497,059	11,306,661
Washington	18		75	8		83	74	7	25	106	581,317	690,942	1,272,259	1,440,276		1,440,276
West Virginia	217	70	914	286	86	1,286	12	3	264	279	49,790,492	751,829	50,542,321	74,137,116	24,484,832	98,621,948
Wyoming	26		333	36	3	372	34		7	41	(1)	(1)	5,498,967	5,517,154		5,517,154
Other States [2]	6	7	38	4	2	44	8		12	20	309,667	64,567	374,234	633,619	453,407	1,087,026
Undistributed		5									21,659,112	241,941		32,411,722	1,062,708	
Total	923	249	5,118	1,088	407	6,613	210	79	1,069	1,378	189,534,426	7,548,186	197,082,612	259,074,487	62,890,249	321,964,736

[1] Included under "Undistributed."
[2] Alaska, Missouri, and New Mexico.

MECHANICAL LOADING

The quantity of coal loaded mechanically at underground mines in the United States continued to advance sharply in 1939 and 1940. There were 85,092,836, 110,711,970, and 147,870,252 net tons mechanically loaded at bituminous coal and lignite mines during 1938, 1939, and 1940, respectively, and 10,151,669, 11,773,833, and 12,326,000 net tons mechanically loaded at Pennsylvania anthracite mines. The percentage of total underground bituminous coal and lignite production that was mechanically loaded increased from 27 in 1938 to 31 in 1939 and 35 in 1940. Detailed statistics on mechanical loading are given in the following tables (30–37). Data in these tables pertain to underground mines and do not include strip mines or equipment used for handling coal on the surface.

TABLE 30.—*Units of mechanized loading equipment sold to bituminous coal, lignite, and Pennsylvania anthracite mines in the United States, 1934–41, as reported by manufacturers* [1]

Type of equipment	1934	1935	1936	1937	1938	1939	1940	1941	Percent of increase or decrease, 1941 from 1940
Mobile loaders	55	115	344	292	241	292	233	368	+57.9
Scrapers [2]	34	22	28	29	10	26	39	11	−71.8
Conveyors [3]	610	681	994	1,095	990	1,311	1,762	2,130	+20.9
Pit-car loaders	26	28	11	32	139	2	3	10	+233.3

[1] Data for 1934–37 include reports from 28 manufacturers; data for 1938, 1939, 1940, and 1941 include reports from 29, 31, 32, and 32 manufacturers, respectively.
[2] Reported as scrapers or scraper haulers and hoists.
[3] Includes hand-loaded conveyors and those equipped with duckbills and other self-loading heads. As sales of both loading heads and shaker conveyors are counted, figures involve a certain measure of overlap that cannot be determined accurately. It should also be noted that a small number of conveyors were for use in conjunction with mobile loading machines.

TABLE 31.—*Sales of mechanized loading equipment in the United States in 1941, compared with total number of machines in active use in preceding years*

Type of equipment	Number of machines in active use, as reported by mine operators [1]									1941 Number of machines sold, as reported by manufacturers
	1931	1932	1933	1934	1935	1936	1938	1939	1940	
Bituminous coal and lignite mines:										
Mobile loading machines	583	548	523	534	657	980	1,405	1,573	1,720	367
Scrapers	146	128	93	119	78	106	117	131	116	8
Pit-car loaders	3,428	3,112	2,453	2,288	2,098	1,851	1,392	873	697	10
Conveyors equipped with duckbills and other self-loading heads	165	159	132	157	179	234	346	559	656	(2)
Hand-loaded conveyors—number of units	(3)	(3)	525	574	670	936	1,526	1,834	2,263	[4] 1,800
Anthracite mines (Pennsylvania):										
Mobile loading machines	5	11	18	14	1	(5)	(6)	(6)	(5)	1
Scrapers	457	479	455	517	507	[7] 504	545	535	[7] 547	3
Pit-car loaders	28	24	19	25	22	(6)	(6)	(6)	(6)	----------
Conveyors equipped with duckbills and other self-loading heads	1	17	12	13	30	(6)	(6)	(6)	(6)	(2)
Hand-loaded conveyors—number of units	547	818	940	1,338	1,563	[8] 1,790	[9] 1,831	[9] 1,997	[8] 2,189	[4] 330

[1] Data for bituminous coal and lignite mines for 1937 not available. Minerals Yearbook, 1939, p. 857, shows for 1937 in the anthracite mines 539 scrapers and 1,855 conveyors and pit-car loaders including a few mobile loaders.
[2] Included with hand-loaded conveyors.
[3] Number of units not reported.
[4] Reported as face conveyors (hand-loaded), "shaker drives," and "duckbills." Figures for number sold not exactly comparable with number in use in 1940, because of uncertainties in defining what constitutes a conveyor and because of certain overlaps in reporting duckbill loading heads and shaker conveyors.
[5] Included with scrapers.
[6] Included with hand-loaded conveyors.
[7] Includes mobile loading machines.
[8] Includes pit-car loaders and conveyors equipped with duckbills or self-loading heads.
[9] Includes mobile loaders, pit-car loaders, and conveyors equipped with duckbills or self-loading heads.

TABLE 32.—*Comparison of mobile loaders, scrapers, and conveyors in actual use in coal mines in the United States, 1939–40, and sales reported in 1941, by States and regions*

State and region	Mobile loaders: In use in— 1939	Mobile loaders: In use in— 1940	Mobile loaders: Sales in 1941	Scrapers: In use in— 1939	Scrapers: In use in— 1940	Scrapers: Sales in 1941	Conveyors [1]: In use in— 1939	Conveyors [1]: In use in— 1940	Conveyors [1]: Sales in 1941
BITUMINOUS COAL AND LIGNITE									
Northern Appalachian States:									
Pennsylvania	213	296	80	30	25	4	526	613	237
Maryland	------	------	------	------	------	------	48	22	16
Ohio	91	109	31	------	2	------	50	104	145
Michigan	------	------	------	------	------	------	1	5	------
Southern Appalachian States.									
Alabama	16	25	22	45	46	------	193	245	142
Kentucky	68	101	37	3	------	------	161	210	212
Tennessee	8	2	2	------	------	------	62	57	[2] 49
West Virginia	331	363	107	7	7	4	586	832	712
Virginia	31	33	5	------	------	------	39	58	66
Middle Western States:									
Illinois	540	519	65	------	------	------	29	26	99
Indiana	138	130	8	------	------	------	26	21	2
Trans-Mississippi States [3]	137	142	10	46	36	------	672	726	120
Total bituminous coal and lignite	1,573	1,720	367	131	116	8	2,393	2,919	1,800
ANTHRACITE									
Pennsylvania	(4)	(5)	1	535	[5] 547	3	[4] 1,997	2,189	330
Grand total	1,573	1,720	368	666	663	11	4,390	5,108	2,130

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.
[2] Includes North Carolina.
[3] Includes Arkansas, Colorado, Iowa, Kansas, Montana (bituminous coal), New Mexico, North Dakota (lignite), Oklahoma, Utah, Washington, and Wyoming.
[4] Mobile loaders and pit-car loaders included with conveyors.
[5] Mobile loaders included with scrapers.

TABLE 33.—*Bituminous coal and lignite mechanically loaded underground in the United States, 1938–40, by types of machines*

Type of machine	1938: Net tons	1938: Percent	1939: Net tons	1939: Percent	1940: Net tons	1940: Percent
Mobile loading machines	57,824,252	68 0	76,441,608	69 0	100,961,745	68 3
Scraper loaders	1,030,468	1 2	1,007,029	.9	1,255,396	.8
Conveyors equipped with duckbills and other self-loading devices	4,248,434	5 0	6,759,027	6 1	10,361,694	7.0
Pit-car loaders	5,652,562	6 6	5,038,539	4.6	3,979,209	2.7
Hand-loaded conveyors	16,337,120	19 2	21,465,767	19.4	31,312,208	21.2
Total loaded mechanically	85,092,836	100.0	110,711,970	100.0	147,870,252	100.0

TABLE 34.—*Mechanical loading underground in bituminous coal and lignite mines in the United States in 1939, by States*

[Includes all soft-coal mines that produced any part of their tonnage with the aid of mechanical loading devices in 1939]

State	Number of mines				Number of machines					Production mechanically loaded (net tons)			Total production at mines using mechanical loading devices (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills and other self-loading devices	Pit-car loaders	Hand-loaded conveyors [3]	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	12	16	10	38	16	45	20	28	173	1,041,038	1,867,707	2,908,745	2,759,321	2,590,053	3,495,565	8,844,939
Arkansas	2	23	1	26	3	12			68	117,536	530,697	648,233	(4)	501,729	(4)	697,662
Colorado	23	16	3	42	18		106	15	80	1,328,117	534,955	1,863,072	2,208,448	525,722	396,711	3,130,881
Illinois	43	8	18	69	540			302	29	24,842,466	1,727,733	26,570,199	19,317,449	464,363	7,948,277	27,730,089
Indiana	18	11	4	33	138			36	26	6,063,606	324,645	6,388,251	5,638,768	187,521	831,987	6,658,276
Iowa		3		3					6		66,422	66,422		152,105		152,105
Kansas	1			1	1					(4)		(4)	(4)			(4)
Kentucky	36	22	11	69	68	3	75	65	86	3,643,893	1,451,735	5,095,628	8,232,794	5,484,520	2,921,240	16,638,554
Maryland		3		3					48		(4)	(4)		(4)		(4)
Michigan		1		1					1		(4)	(4)		(4)		(4)
Montana (bituminous coal)	5		1	6	46		2	1		(4)	(4)	1,405,393	(4)		(4)	1,405,393
New Mexico	2			2	3	13				(4)		(4)	(4)			(4)
North Dakota (lignite)	1			1	3					(4)		(4)	(4)			(4)
Ohio	12	13	4	29	91		14	3	36	5,071,153	351,647	5,422,800	6,626,164	944,580	161,816	7,732,560
Oklahoma	3	8	1	12		13			22	46,339	257,878	304,217	(4)	254,350	(4)	305,175
Pennsylvania	43	49	12	104	213	30	35	216	491	10,590,180	7,098,454	17,688,634	21,484,832	12,351,151	6,138,189	39,974,172
Tennessee	1	9	4	14	8		5		57	(4)	(4)	602,191	(4)	999,272	(4)	1,747,407
Utah	8	5	1	14	34		15		43	2,135,610	324,096	2,459,706	2,306,547	(4)	(4)	2,941,364
Virginia	13	4		17	31		2		37	1,598,130	835,277	2,433,407	3,873,885	1,022,853		4,896,738
Washington	1	6		7			5		80	(4)	(4)	710,603	(4)	(4)		850,601
West Virginia	67	75	44	186	331	7	79	164	507	21,450,142	9,028,992	30,479,134	23,550,873	15,799,787	17,178,475	56,529,135
Wyoming	13	3	8	24	29	8	201	43	44	4,309,930	584,145	4,894,075	2,834,269	169,671	1,955,300	4,959,240
Undistributed:																
East of Mississippi River										1,969,524	832,217	314,984	2,161,851	1,862,169	1,114,600	599,481
West of Mississippi River											687,706	456,276				653,435

Total 1939	304	275	122	701	1,573	131	559	873	1,834	84,207,664	26,504,306	110,711,970	100,995,201	43,309,846	42,142,160	186,447,207
1938	275	270	100	645	1,405	117	346	1,392	1,526	63,103,154	21,989,682	85,092,836	74,471,291	41,603,659	31,409,299	147,484,249
Percent change, 1939 from 1938	+10.5	+1.9	+22.0	+8.7	+12.0	+12.0	+61.6	−37.3	+20.2	+33.4	+20.5	+30.1	+35.6	+4.1	+34.2	+26.4

[1] Includes those mines in which all the tonnage mechanically loaded was obtained with machines that substantially eliminate hand shoveling, that is, mobile loaders, scrapers, and conveyors equipped with duckbills and other self-loading heads. Some mines in this class also use conveyors in conjunction with mobile loaders to perform initial phase of transportation.

[2] Includes those mines in which all the tonnage mechanically loaded was obtained with hand-loaded conveyors and pit-car loaders

[3] Number of units.

[4] Included under "Undistributed" to avoid disclosing individual operations.

TABLE 35.—*Mechanical loading underground in bituminous coal and lignite mines in the United States in 1940, by States*

[Includes all soft-coal mines that produced any part of their tonnage with the aid of mechanical loading devices in 1940]

State	Number of mines				Number of machines					Production mechanically loaded (net tons)			Total production at mines using mechanical loading devices (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills and other self-loading devices	Pit-car loaders	Hand-loaded conveyors [3]	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	16	17	9	42	25	46	9	38	236	1,603,194	3,401,717	5,004,911	4,417,139	4,146,343	4,136,397	12,699,879
Arkansas	2	29		31		12			80	(4)	(4)	945,052	(4)	(4)		945,881
Colorado	23	22	4	49	20		113	1	95	1,868,794	683,932	2,552,726	2,462,176	806,032	517,548	3,785,756
Illinois	49	5	11	65	519			209	26	28,156,030	1,364,457	29,520,487	22,460,677	378,424	7,739,406	30,578,507
Indiana	19	8	4	31	130		6	27	15	7,176,040	230,880	7,406,920	6,475,652	118,045	837,248	7,430,945
Iowa	1	3		4		1			11	(4)	(4)	132,947	(4)	(4)		322,102
Kentucky	42	26	9	77	101		91	48	119	5,494,346	1,656,208	7,150,554	9,392,388	7,560,746	3,031,280	19,984,414
Maryland		3		3					22		(4)	(4)		(4)		(4)
Michigan		1		1					5		(4)	(4)		(4)		(4)
Montana (bituminous coal)	5		2	7	48		2	6		(4)	(4)	1,511,123	(4)		(4)	1,519,661
New Mexico	2		1	3	8	13			1	(4)	(4)	(4)	(4)		(4)	(4)
North Dakota (lignite)	2			2	3		1			(4)		(4)	(4)			(4)
Ohio	20	13	3	36	109	2	49		55	7,750,819	493,023	8,243,842	10,628,539	920,610	605,071	12,154,220
Oklahoma	1	11		12		2			28	(4)	(4)	422,692	(4)	(4)		429,544
Pennsylvania	64	50	18	132	296	25	46	236	567	18,031,402	9,203,654	27,235,056	34,285,988	15,793,581	6,912,560	56,992,129
Tennessee	1	14	3	18	2		6		51	93,601	622,215	715,816	(4)	1,758,163	(4)	2,460,835
Utah	10	6		16	31		16		41	2,519,675	353,285	2,872,960	2,625,496	588,789		3,214,285
Virginia	12	4	2	18	33		5		53	1,996,634	1,111,788	3,108,422	4,317,934	(4)		5,831,090
Washington	4	7		11	1	1	8		75	62,000	733,494	795,494	321,436	767,610	(4)	1,089,046
West Virginia	89	93	46	228	363	7	98	91	734	30,878,128	13,100,403	43,978,531	35,531,433	23,507,697	16,016,364	75,055,494
Wyoming	10	3	12	25	31	7	206	41	49	4,799,234	571,885	5,371,119	2,517,545	150,505	2,776,369	5,444,419
Undistributed:																
East of Mississippi River											388,831	388,831	2,446,886	1,840,897	1,051,473	667,268
West of Mississippi River										2,148,938	1,375,645	512,769		1,536,685		775,657

Total: 1940	372	315	124	811	1,720	116	656	697	2,263	112,578,835	35,291,417	147,870,252	137,883,239	59,874,127	43,623,716	241,381,132
1939	304	275	122	701	1,573	131	559	873	1,834	84,207,664	26,504,306	110,711,970	100,995,201	43,309,846	42,142,160	186,447,207
Percent change, 1940 from 1939	+22.4	+14.5	+1.6	+15.7	+9.3	−11.5	+17.4	−20.2	+23.4	+33.7	+33.2	+33.6	+36.5	+38.2	+3.5	+29.5

[1] Includes those mines in which all the tonnage mechanically loaded was obtained with machines that substantially eliminate hand shoveling, that is, mobile loaders, scrapers, and conveyors equipped with duckbills and other self-loading heads. Some mines in this class also use conveyors in conjunction with mobile loaders to perform initial phase of transportation.

[2] Includes those mines in which all the tonnage mechanically loaded was obtained with hand-loaded conveyors and pit-car loaders.

[3] Number of units.

[4] Included under "Undistributed" to avoid disclosing individual operations.

TABLE 36.—*Comparative changes in underground mechanical loading of bituminous coal and lignite in the United States, 1939–40, by principal types of machines and by States*

State	1939 (net tons)			1940 (net tons)			Increase or decrease, 1940 from 1939						Percent handled by each class			
							Net tons			Percent			1939		1940	
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Loaded by machines [1]	Handled by conveyors [2]
Alabama	1,041,038	1,867,707	2,908,745	1,603,194	3,401,717	5,004,911	+562,156	+1,534,010	+2,096,166	+54.0	+82.1	+72.1	35.8	[5] 64.2	32.0	[5] 68.0
Arkansas	117,536	530,697	648,233	(4)	(4)	945,052	+1,284	(4)	+296,819	+1.1	(4)	+45.8	18.1	[5] 81.9	(4)	(4)
Colorado	1,328,117	534,955	1,863,072	1,868,794	683,932	2,552,726	+540,677	+148,977	+689,654	+40.7	+27.8	+37.0	71.3	[5] 28.7	73.2	[6] 26.8
Illinois	24,842,466	1,727,733	26,570,199	28,156,030	1,364,457	29,520,487	+3,313,564	−363,276	+2,950,288	+13.3	−21.0	+11.1	[7] 93.5	[8] 6.5	[7] 95.4	[8] 4.6
Indiana	6,063,606	324,645	6,388,251	7,176,040	230,880	7,406,920	+1,112,434	−93,765	+1,018,669	+18.3	−28.9	+15.9	[7] 94.9	[8] 5.1	[9] 96.9	3.1
Iowa	-------	66,422	66,422	(4)	(4)	132,947	(4)	(4)	+66,525	(4)	(4)	+100.2	-------	100.0	(4)	(4)
Kansas	(4)	-------	(4)	-------	-------	-------	(4)	-------	(4)	(4)	-------	(4)	100.0	-------	-------	-------
Kentucky	3,643,893	1,451,735	5,095,628	5,494,346	1,656,208	7,150,554	+1,850,453	+204,473	+2,054,926	+50.8	+14.1	+40.3	71.5	28.5	76.8	23.2
Maryland	-------	(4)	(4)	-------	(4)	(4)	-------	(4)	(4)	(4)	(4)	(4)	-------	100.0	-------	100.0
Michigan	-------	(4)	(4)	-------	(4)	(4)	-------	(4)	(4)	(4)	(4)	(4)	-------	100.0	-------	100.0
Montana (bituminous coal)	(4)	(4)	1,405,393	(4)	(4)	1,511,123	(4)	(4)	+105,730	(4)	(4)	+7.5	(4)	(4)	(4)	(4)
New Mexico	(4)	-------	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	100.0	-------	(4)	(4)
North Dakota (lignite)	(4)	-------	(4)	(4)	-------	(4)	(4)	-------	(4)	(4)	-------	(4)	100.0	-------	100.0	-------
Ohio	5,071,153	351,647	5,422,800	7,750,819	493,023	8,243,842	+2,679,666	+141,376	+2,821,042	+52.8	+40.2	+52.0	[9] 93.5	[8] 6.5	[10] 94.0	[8] 6.0
Oklahoma	46,339	257,878	304,217	(4)	(4)	422,692	(4)	(4)	+118,475	(4)	(4)	+38.9	[11] 15.2	[5] 84.8	(4)	(4)
Pennsylvania	10,590,180	7,098,454	17,688,634	18,031,402	9,203,654	27,235,056	+7,441,222	+2,105,200	+9,546,422	+70.2	+29.7	+54.0	[9] 59.9	[5] 40.1	[9] 66.2	[5] 33.8
Tennessee	(4)	(4)	602,191	93,601	622,215	715,816	(4)	(4)	+113,625	(4)	(4)	+18.9	(4)	(4)	13.1	[5] 86.9
Utah	2,135,610	324,096	2,459,706	2,519,675	353,285	2,872,960	+384,065	+29,189	+413,254	+18.0	+9.0	+16.8	[10] 86.8	[5] 13.2	[10] 87.7	[8] 12.3
Virginia	1,598,130	835,277	2,433,407	1,996,634	1,111,788	3,108,422	+398,504	+276,511	+675,015	+24.9	+33.1	+27.7	[9] 65.7	[5] 34.3	[9] 64.2	[5] 35.8
Washington	(4)	(4)	710,603	62,000	733,494	795,494	(4)	(4)	+84,891	(4)	(4)	+11.9	(4)	(4)	7.8	[5] 92.2
West Virginia	21,450,142	9,028,992	30,479,134	30,878,128	13,100,403	43,978,531	+9,427,986	+4,071,411	+13,499,397	+44.0	+45.1	+44.3	[9] 70.4	[5] 29.6	[10] 70.2	[5] 29.8
Wyoming	4,309,930	584,145	4,894,075	4,799,234	571,885	5,371,119	+489,304	−12,260	+477,044	+11.4	−2.1	+9.7	88.1	[5] 11.9	89.4	[5] 10.6
Undistributed:																
East of Mississippi River	1,969,524	832,217	314,984	-------	388,831	388,831	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)
West of Mississippi River		687,706	456,276	2,148,938	1,375,645	512,769	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)
Total	84,207,664	26,504,306	110,711,970	112,578,835	35,291,417	147,870,252	+28,371,171	+8,787,111	+37,158,282	+33.7	+33.2	+33.6	76.1	23.9	76.1	23.9

[1] Includes mobile loaders, scrapers and duckbills.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Principally by conveyors.
[4] Included under "Undistributed" to avoid disclosing individual operations.
[5] All by conveyors.
[6] Practically all by conveyors.
[7] All by mobile loaders.
[8] Principally by pit-car loaders.
[9] Practically all by mobile loaders.
[10] Principally by mobile loaders.
[11] All by scrapers.
[12] Included in total; tons increase or decrease and percentage by types not given because State groups not comparable in 1939 and 1940.

TABLE 37.—*Bituminous coal and lignite mined in the United States underground and from strip pits, and method of loading underground, 1939–40, by States, in net tons*

State	1939					1940				
	Mined by stripping	Mined underground			Grand total production	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total			Hand-loaded	Machine-loaded	Total	
Alabama	61,611	9,076,319	2,908,745	11,985,064	12,046,675	75,641	10,243,611	5,004,911	15,248,522	15,324,163
Arkansas	25,454	478,351	648,233	1,126,584	1,152,038	25,808	482,751	945,052	1,427,803	1,453,611
Colorado	(1)	(1)	1,863,072	(1)	5,923,210	12,460	4,023,556	2,552,726	6,576,282	6,588,742
Illinois	12,088,536	8,123,956	26,570,199	34,694,155	46,782,691	13,075,255	8,014,688	29,520,487	37,535,175	50,610,430
Indiana	8,897,370	1,657,151	6,388,251	8,045,402	16,942,772	10,039,078	1,422,574	7,406,920	8,829,494	18,868,572
Iowa	585,676	2,295,459	66,422	2,361,881	2,947,557	725,912	2,372,318	132,947	2,505,265	3,231,177
Kansas	1,978,577	(1)	(1)	696,114	2,674,691	2,755,704	823,248		823,248	3,578,952
Kentucky	793,142	36,667,798	5,095,628	41,763,426	42,556,568	862,475	41,127,875	7,150,554	48,278,429	49,140,904
Maryland		(1)	(1)	1,442,728	1,442,728		(1)	(1)	1,503,433	1,503,433
Michigan		(1)	(1)	456,754	456,754		(1)	(1)	410,169	410,169
Missouri	2,273,555	999,995		999,995	3,273,550	1,980,846	1,115,895		1,115,895	3,096,741
Montana (bituminous coal)	(1)	(1)	1,405,393	(1)	2,756,036	1,126,932	180,881	1,511,123	1,692,004	2,818,936
Montana, South Dakota, and Texas (all lignite)	75,701	829,852		829,852	905,553	106,718	614,049		614,049	720,767
New Mexico		(1)	(1)	1,230,060	1,230,060		(1)	(1)	1,110,615	1,110,615
North Dakota (lignite)	1,343,946	(1)	(1)	728,547	2,072,493	1,405,590	(1)	(1)	812,844	2,218,434
Ohio	4,170,903	10,695,850	5,422,800	16,118,650	20,289,553	5,047,597	9,480,113	8,243,842	17,723,955	22,771,552
Oklahoma	500,396	382,949	304,217	687,166	1,187,562	621,641	601,648	422,692	1,024,340	1,645,981
Pennsylvania	2,964,839	71,930,640	17,688,634	89,619,274	92,584,113	4,230,162	85,137,781	27,235,056	112,372,837	116,602,999
Tennessee	(1)	(1)	602,191	(1)	5,185,481	1,654	5,290,986	715,816	6,006,802	6,008,456
Texas (bituminous coal)		16,259		16,259	16,259		14,137		14,137	14,137
Utah	(1)	(1)	2,459,706	(1)	3,284,904		702,626	2,872,960	3,575,586	3,575,586
Virginia		11,097,567	2,433,407	13,530,974	13,530,974	6,400	12,233,253	3,108,422	15,341,675	15,348,075
Washington	(1)	(1)	710,603	(1)	1,690,442	15,960	838,898	795,494	1,634,392	1,650,352
West Virginia	592,917	77,289,883	30,479,134	107,769,017	108,361,934	873,583	81,585,507	43,978,531	125,564,038	126,437,621
Wyoming	178,227	300,987	4,894,075	5,195,062	5,373,289	177,920	259,003	5,371,119	5,630,122	5,808,042
Other States [2]		187,438		187,438	187,438		233,053		233,053	233,053
Undistributed	1,191,733	14,390,318	771,260	17,648,340			2,935,461	901,600		
Total	37,722,583	246,420,772	110,711,970	357,132,742	394,855,325	43,167,336	269,733,912	147,870,252	417,604,164	460,771,500

[1] Included under "Undistributed."

[2] Alaska, Arizona, Georgia, Idaho, and Oregon.

MECHANICAL CLEANING

Bituminous coal mechanically cleaned increased from 63,454,588 net tons in 1938 to 79,376,672 tons in 1939 and 102,205,186 tons in 1940. During the 3 years, this represents annual increases in mechanical cleaning of 18, 20, and 22 percent, respectively, of the total bituminous coal and lignite output. No mechanical cleaning plants have been installed at lignite mines. Detailed data on mechanical cleaning are shown in the following tables (38–44).

Consumer-operated cleaning plants include plants owned by steel companies which receive coal from various mines (but usually from affiliated coal companies), clean it, and then consume it directly at the plant.

TABLE 38.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, 1939–40, in net tons of clean coal* [1]

Method of cleaning	1939 (net tons)	1940 (net tons)	Increase, 1940 over 1939	
			Net tons	Percent
By wet methods:				
At mines	60,881,144	78,475,302	17,594,158	28.9
At central washeries operated by consumers	6,800,587	8,750,220	1,949,633	28.7
Total wet methods	67,681,731	87,225,522	19,543,791	28.9
By pneumatic methods	11,694,941	14,979,664	3,284,723	28.1
Grand total	79,376,672	102,205,186	22,828,514	28.8

[1] Figures do not include Alaska, which had 1 wet-washing installation.

TABLE 39.—*Bituminous coal cleaned in the United States, 1939–40, by types of equipment in actual operation* [1]

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvani included]

Type of equipment	Plants in operation		Net tons of clean coal		Increase or decrease, 1940 from 1939		Percent cleaned by each type	
	1939	1940	1939	1940	Net tons	Percent	1939	1940
Wet methods:								
Jigs	175	186	37,003,557	46,999,035	+9,995,478	+27.0	46.6	46.0
Concentrating tables	11	13	1,402,584	2,330,413	+927,829	+66 2	1.8	2.3
Jigs in combination with concentrating tables	20	16	3,255,987	2,765,237	−490,750	−15.1	4.1	2.7
Jigs in combination with launders and upward-current classifiers [2]	10	11	2,610,959	4,408,148	+1,797,189	+68.8	3.3	4.3
Launders and upward-current classifiers	112	124	23,408,644	30,722,689	+7,314,045	+31.2	29.5	30.0
Total wet methods	328	350	67,681,731	87,225,522	+19,543,791	+28.9	85.3	85.3
Pneumatic methods	69	77	11,694,941	14,979,664	+3,284,723	+28.1	14.7	14.7
Grand total	[3] 397	[3] 427	79,376,672	102,205,186	+22,828,514	+28.8	100.0	100.0

[1] Figures do not include Alaska, which had 1 wet-washing installation.
[2] Includes 1 plant in 1939 with concentrating tables and launders.
[3] Number of plants using both wet and pneumatic methods was 32 in 1939 and 41 in 1940.

TABLE 40.—*Total production of all coal at bituminous mines in the United States having cleaning plants, 1939–40, in net tons* [1]

[Does not include any estimate for mines that may ship to consumer-operated plants]

Type of equipment	1939	1940	Increase or decrease, 1940 from 1939	
			Net tons	Percent
Wet methods:				
Jigs	63,369,947	75,391,008	+12,021,061	+19.0
Concentrating tables	1,504,393	1,733,048	+228,655	+15.2
Jigs in combination with concentrating tables	3,846,666	3,385,168	−461,498	−12.0
Jigs in combination with launders and upward-current classifiers	4,494,650	7,026,222	+2,531,572	+56.3
Launders and upward-current classifiers	46,591,743	56,412,328	+9,820,585	+21.1
Total wet methods	119,807,399	143,947,774	+24,140,375	+20.1
Pneumatic methods	31,381,920	41,129,603	+9,747,683	+31.1
Grand total	151,189,319	185,077,377	+33,888,058	+22.4
Less duplication [2]	17,928,323	23,405,810	+5,477,487	+30.6
Net total	133,260,996	161,671,567	+28,410,571	+21.3
United States production of bituminous coal [3]	394,706,908	460,597,656	+65,890,748	+16.7
Percent produced at mines having cleaning plants	33.8	35 1		

[1] Figures do not include Alaska, which had 1 wet-washing installation.
[2] Mines using both wet and pneumatic methods.
[3] For historical comparison, United States production figures include lignite. Alaska not included in total production.

TABLE 41.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, 1939-40, by States* [1]

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania included]

State	Plants in operation		Net tons of clean coal		Increase or decrease, 1940 from 1939		Percent of State output mechanically cleaned	
	1939	1940	1939	1940	Net tons	Percent	1939	1940
Alabama	52	52	9,938,993	12,923,860	+2,984,867	+30.0	82.5	84.3
Colorado	11	10	793,271	1,067,856	+274,585	+34 6	13 4	16.2
Illinois	45	47	14,108,576	18,840,805	+4,732,229	+33 5	30.2	37.2
Indiana	16	16	3,589,173	5,103,522	+1,514,349	+42 2	21.2	27.0
Kansas	6	8	1,138,039	1,620,407	+482,368	+42 4	42 5	45 3
Kentucky	12	13	2,116,523	2,004,360	−112,163	−5 3	5 0	4 1
Missouri	10	10	1,054,664	1,236,799	+182,135	+17.3	32.2	39.9
Ohio	5	6	2,800,280	3,533,632	+733,352	+26 2	13 8	15.5
Pennsylvania [2]	53	58	21,462,135	27,616,594	+6,154,459	+28.7	23.2	23 7
Tennessee	4	6	320,206	314,541	−5,665	−1 8	6 2	5 2
Virginia	15	19	1,272,296	2,315,560	+1,043,264	+82.0	9 4	15.1
Washington	18	18	1,366,754	1,362,856	−3,898	−.3	80.9	82.6
West Virginia [3]	108	115	18,812,410	23,384,440	+4,572,030	+24 3	17.4	18 5
Undistributed:								
East of Mississippi River	4	3	65,547	64,785	−762	−1 2		
West of Mississippi River	6	5	537,805	815,169	+277,364	+51.6		
Total	[4] 365	[5] 386	79,376,672	102,205,186	+22,828,514	+28 8	20.1	22.2

[1] Excludes Alaska.
[2] Includes some coal mined in Pennsylvania and cleaned in Ohio.
[3] Includes some coal mined in West Virginia and cleaned in Ohio.
[4] Represents 32 plants using both wet and pneumatic methods of cleaning plus 333 plants using onl y 1 of the cleaning methods.
[5] Represents 41 plants using both wet and pneumatic methods of cleaning plus 345 plants using only 1 of the cleaning methods.

TABLE 42.—*Method of mining at bituminous coal mines in the United States served by cleaning plants, 1938–40* [1]

[Does not include any estimate for mines that may ship to consumer-operated plants]

Method of mining in use	Total production from mines that move coal to cleaning plants (net tons)[2]			Increase, 1940 over 1939	
	1938	1939	1940	Net tons	Percent
Mined from strip pits	15,213,564	17,960,049	20,029,770	2,069,721	11.5
Mechanically loaded underground	37,195,439	53,495,851	66,148,465	12,652,614	23.7
Hand-loaded underground	55,828,538	61,805,096	75,493,332	13,688,236	22.1
Total	108,237,541	133,260,996	161,671,567	28,410,571	21.3

[1] Excludes Alaska.
[2] Based upon shipping weights and includes some marketable coal that did not pass through cleaning plants.

TABLE 43.—*Result of operations at bituminous coal cleaning plants in the United States in 1939, by States, in net tons* [1]

State	Total raw coal moved to cleaning plants [2]	Coal obtained in cleaning process	Refuse resulting in cleaning process [2]	Percent of refuse to raw coal [3]	Total production from mines that moved coal to cleaning plants [4]
Alabama	11,318,668	9,938,993	1,379,675	12.2	10,911,118
Colorado	(5)	(5)	(5)	9.2	(5)
Illinois	16,408,336	14,108,576	2,299,760	14.0	28,194,800
Indiana	4,405,407	3,589,173	816,234	18.5	6,910,114
Kansas	1,400,011	1,138,039	261,972	18.7	1,328,866
Kentucky	2,275,575	2,116,523	159,052	7.0	4,384,939
Missouri	1,315,185	1,054,664	260,521	19.8	1,904,759
Ohio	3,323,255	2,800,280	522,975	15.7	3,231,827
Pennsylvania [6]	(5)	(5)	(5)	6.5	(5)
Tennessee	352,918	320,206	32,712	9.3	1,098,871
Virginia	1,399,522	1,272,296	127,226	9.1	4,514,378
Washington	1,549,408	1,366,754	182,654	11.8	1,548,729
West Virginia [7]	20,766,527	18,812,410	1,954,117	9.4	42,445,104
Other States [8]	17,161,041	16,058,171	1,102,870		26,787,491
Total at mines only [9]	81,675,853	72,576,085	9,099,768	11.1	133,260,996
Consumer plants [10]	7,140,590	6,800,587	340,003	4.8	
Grand total	88,816,443	79,376,672	9,439,771	10.6	

[1] Excludes Alaska.
[2] Exact figures on raw coal or refuse could not be furnished by many operators, in such instances, estimates were made from all available information at hand.
[3] In Alabama (for example) for every 100 tons of raw coal cleaned in 1939, an average of 12.2 tons of refuse was discarded and 87.8 tons of clean marketable coal was obtained.
[4] Based upon shipping weights, includes some marketable coal that did not pass through cleaning plants.
[5] Included under "Other States."
[6] Includes some coal mined in Pennsylvania and cleaned in Ohio.
[7] Includes some coal mined in West Virginia and cleaned in Ohio.
[8] Includes Arkansas, Colorado, Maryland, Michigan, Montana, New Mexico, Pennsylvania, Texas, and Utah.
[9] Includes all mechanical cleaning other than washeries operated by consumer steel companies.
[10] Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

TABLE 44.—*Result of operations at bituminous coal cleaning plants in the United States in 1940, by States, in net tons* [1]

State	Total raw coal moved to cleaning plants [2]	Coal obtained in cleaning process	Refuse resulting in cleaning process [2]	Percent of refuse to raw coal [3]	Total production from mines that moved coal to cleaning plants [4]
Alabama	14,758,435	12,923,860	1,834,575	12.4	14,030,911
Colorado	(5)	(5)	(5)	9.0	(5)
Illinois	22,428,658	18,840,805	3,587,853	16.0	31,803,487
Indiana	5,964,599	5,103,522	861,077	14.4	8,435,450
Kansas	1,981,870	1,620,407	361,463	18.2	2,072,312
Kentucky	2,246,309	2,004,360	241,949	10.8	5,547,417
Missouri	1,564,883	1,236,799	328,084	21.0	1,640,433
Ohio	4,187,955	3,533,632	654,323	15.6	4,469,653
Pennsylvania [6]	(5)	(5)	(5)	8.4	(5)
Tennessee	343,509	314,541	28,968	8.4	1,276,875
Virginia	2,514,659	2,315,560	199,099	7.9	7,054,638
Washington	1,599,221	1,362,856	236,365	14.8	1,491,793
West Virginia [7]	26,073,317	23,384,440	2,688,877	10.3	52,002,066
Other States [8]	22,743,963	20,814,184	1,929,779		31,846,532
Total at mines only [9]	106,407,378	93,454,966	12,952,412	12.2	161,671,567
Consumer plants [10]	9,193,244	8,750,220	443,024	4.8	
Grand total	115,600,622	102,205,186	13,395,436	11.6	

[1] Excludes Alaska.
[2] Exact figures on raw coal or refuse could not be furnished by many operators; in such instances, estimates were made from all available information at hand.
[3] In Alabama (for example) for every 100 tons of raw coal cleaned in 1940, an average of 12.4 tons of refuse was discarded and 87.6 tons of clean coal was obtained.
[4] Based upon shipping weights, includes some marketable coal that did not pass through cleaning plants.
[5] Included under "Other States."
[6] Includes some coal mined in Pennsylvania and cleaned in Ohio.
[7] Includes some coal mined in West Virginia and cleaned in Ohio.
[8] Includes Arkansas, Colorado, Georgia, Michigan, Montana, New Mexico, Pennsylvania, and Utah.
[9] Includes all mechanical cleaning other than washeries operated by consumer steel companies.
[10] Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

DETAILED STATISTICS BY STATES AND COUNTIES

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*

[Exclusive of mines producing less than 1,000 tons]

ALABAMA

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods): Underground	Surface: In strip pits	Surface: All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
Bibb	592,190	13,703	1,937	13,943	−3,529	618,244	$2.40	1,090	14	163	1,267	180	2.70
Blount	93,577	35,209	510	1,361	−1,434	129,223	2.42	341	17	47	405	178	1.79
Cherokee	----------	12,441	----------	----------	----------	12,441	2.11	23	----------	4	27	218	2.11
Cullman	----------	34,347	73	----------	----------	34,420	2.49	132	----------	19	151	161	1.42
Etowah	10,753	11,757	3	----------	----------	22,513	2.07	66	----------	10	76	130	2.28
Jefferson	6,781,701	243,500	69,544	24,251	−11,289	7,107,707	2.28	10,110	----------	1,461	11,571	186	3.30
Marion	208,599	38,200	1,249	351	+1,160	249,559	2.90	520	6	78	604	156	2.65
Shelby	312,765	76,792	2,168	1,166	−977	391,914	2.71	776	----------	166	942	167	2.50
Tuscaloosa	70,946	52,379	7	510	----------	123,842	1.95	275	6	43	324	181	2.11
Walker	2,146,200	104,819	32,827	580	−6,602	2,277,824	2.20	3,169	47	526	3,742	163	3.73
Other counties (De Kalb, Fayette, Jackson, Madison, St. Clair, and Winston)	993,781	49,656	11,113	30,545	−6,107	1,078,988	2.32	1,441	----------	334	1,775	222	2.73
Total Alabama	11,210,512	672,803	119,431	[4] 72,707	−28,778	12,046,675	2.30	17,943	90	2,851	20,884	183	3.16

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods): Underground	Surface: In strip pits	Surface: All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
ALASKA													
Total Alaska	143,549		10	[4] 3,305	+1,553	148,417	$2.82	66		22	88	289	5.84
ARIZONA, GEORGIA, IDAHO, AND OREGON													
Total Arizona, Georgia, Idaho, and Oregon	22,706	14,710	496	[4] 376	+733	39,021	$2.96	122		35	157	154	1.61
ARKANSAS													
Franklin	105,767	4,351	1,065	1,461		112,644	$3.43	397	17	54	468	100	2.41
Johnson	175,115	16,392	138	2,240	+122	194,007	2.76	523		111	634	111	2.75
Logan	356,406	2,977	807	523	−1,350	359,363	3.67	1,130		211	1,341	108	2.49
Sebastian	400,162	24,221	110	2,710	+1,035	428,238	2.79	1,097	28	189	1,314	103	3.17
Other counties (Pope and Scott)	56,077	928	10	614	+157	57,786	3.76	215		32	247	123	1.90
Total Arkansas	1,093,527	48,869	2,130	[4] 7,548	−36	1,152,038	3.17	3,362	45	597	4,004	107	2.70

COLORADO

Boulder	196,057	395,936	5,226	10,716	+498	608,433	$2.84	671		108	779	221	3.53
Delta	28,705	28,050	776	4,083		61,614	2.40	60		22	82	201	3.74
Elbert		7,866	157			8,023	2.43	12		2	14	194	2.95
Fremont	163,184	342,315	4,194	2,306	−1,992	510,007	2.50	696		117	813	185	3.40
Garfield	12,717	23,982	39	1,240		37,978	2.27	35		10	45	221	3.81
Gunnison	497,231	23,923	3,795	10,874	−5,398	530,425	2.26	465		96	561	168	5.63
Huerfano	546,804	63,597	4,354	1,662	−1,250	615,167	2.51	796		171	967	164	3.88
La Plata	10,887	17,457	128		−277	28,195	2.18	37		10	47	211	2.85
Las Animas	898,288	54,220	5,170	[5] 111,700	−2,242	1,067,136	2.33	1,395		202	1,597	164	4.07
Mesa	29,931	44,455	148	2,930		77,464	2.08	102		18	120	175	3.68
Moffat	28,342	26,503	55	1,000		55,900	2.07	37		10	47	236	5.05
Routt	670,000	16,413	13,018	32,121	−4,112	727,440	2.44	914		272	1,186	150	4.10
Weld	828,314	265,079	17,960	25,474	−2,197	1,134,630	2.56	1,174		239	1,413	171	4.69
Other counties:													
Archuleta, Montezuma, Montrose, Pitkin, and Rio Blanco	482	7,823	24,109	4		32,418	2.30	35		27	62	250	2.09
El Paso, Jackson, Jefferson, and Larimer	168,723	216,241	3,137	40,769	−490	428,380	2.44	353	(6)	(6)	428	222	4.52
Total Colorado	4,079,665	1,533,860	82,266	[5] 244,879	−17,460	5,923,210	2.47	6,782	(6)	(6)	8,161	176	4.12

ILLINOIS

Franklin	8,148,497	48,562	48,385	133,851	−59,446	8,319,849	$1.69	4,797		1,445	6,242	144	9.27
Fulton	3,351,874	428,205	3,168	9,314	+578	3,793,139	1.42	639	267	447	1,353	210	13.34
Gallatin	1,650	42,921		2,622	+1,378	48,571	1.55	66		13	79	185	3.33
Grundy		123,250	1,294	2,109	−1,746	124,907	2.61	132	13	17	162	173	4.45
Knox	595,853	160,697	1,923	5,361	−2,050	761,784	1.59	195	54	72	321	218	10.86
La Salle	86,145	268,441	5,849	2,367	+4,433	367,235	2.66	433	82	75	590	174	3.58
Livingston		10,011	5	214	+616	10,846	2.98	44	3	10	57	61	3.13
Macoupin	3,041,874	177,300	28,948	129,326	−8,278	3,369,170	1.48	1,895		434	2,329	182	7.95
Madison	1,133,117	591,166	31,614	66,483	+7,109	1,829,489	1.49	1,358		285	1,643	189	5.89
Menard		110,006	2,428	3,681		116,115	2.07	173		18	191	198	3.07
Mercer		24,220	258	887		25,365	2.55	64		9	73	130	2.67
Montgomery	598,392	43,849	3,252	37,801	+2,695	685,989	1.38	570		129	699	98	10.03
Peoria	828,981	343,419	3,462	2,547	−7,338	1,171,071	2.04	1,277	9	103	1,389	146	5.77
Perry	3,035,812	67,555	29,486	33,599	+3,233	3,169,685	1.44	697	423	340	1,460	192	11.33
Randolph	1,123,065	78,460	10,129	20,220	+44	1,231,918	1.29	339	55	170	564	163	13.42
Rock Island		23,731	279	68		24,078	3.20	57		7	64	165	2.28
St. Clair	874,183	1,491,941	41,409	43,184	+3,768	2,454,485	1.52	1,911	116	413	2,440	141	7.12
Saline	3,518,007	60,960	18,734	50,644	+1,428	3,649,773	1.80	2,154	100	582	2,836	162	7.95
Sangamon	1,448,605	580,981	12,944	20,888	+5,301	2,068,719	1.82	2,517		319	2,836	148	4.94
Schuyler		48,241	136	1,030	+1,412	50,819	1.80	113		16	129	181	2.18
Shelby		6,987	97	122		7,206	3.69	36		5	41	177	.90
Stark		19,123	80	32		19,235	2.12	34		5	39	207	2.38
Tazewell	38,551	163,868	1,402	812		204,633	2.12	337		44	381	152	3.53

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*—Continued

ILLINOIS—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods): Underground	Surface: In strip pits	Surface: All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
Vermilion	1,506,885	299,215	106,385	20,712	−9,737	1,923,460	$1.86	2,036	40	224	2,300	173	4.85
Wabash		8,086	60	44		8,190	1.76	26		3	29	128	2.21
Williamson	1,886,921	507,517	5,720	52,172	−21,759	2,430,571	1.57	1,292	150	436	1,878	156	8.29
Other counties [7]	7,745,667	1,042,131	44,035	83,763	+793	8,916,389	1.67	4,006	449	1,314	5,769	176	8.77
Total Illinois	38,964,079	6,770,843	401,482	[4] 723,853	−77,566	46,782,691	1.64	27,198	1,761	6,935	35,894	163	[5] 7.98

INDIANA

County	Loaded for shipment by rail or water	Shipped by truck or wagon	Used by mine employees, etc.	Used at mine for power and heat	Net changes in stocks	Total quantity	Average value per ton	Underground	In strip pits	All others	Total	Average number of full days mines were active	Tons per man-shift
Clay	837,043	469,919	857	9,753	+711	1,318,283	$1.77	150	503	184	837	188	8.36
Daviess		58,571	550	1,248		60,369	1.96	79	5	19	103	184	3.19
Dubois		14,014	85	73		14,172	1.73	24		3	27	190	2.77
Fountain	294	29,920	485	1,892		32,591	1.89	31	51	17	99	118	2.80
Greene	2,017,909	113,715	1,419	15,122	−331	2,147,834	1.54	356	398	339	1,093	181	10.87
Knox	1,779,427	313,300	3,476	19,509	+6,395	2,122,107	1.37	887	22	289	1,198	173	10.22
Martin		18,751	14			18,765	1.60	39		6	45	197	2.11
Parke		124,022	877	6,709	+1,341	132,949	2.25	165	6	37	208	185	3.45
Perry		26,793	47	4		26,844	1.48	38		5	43	222	2.81
Pike	3,308,687	60,915	8,201	16,266	+2,615	3,396,684	1.18	101	454	420	975	211	16.55
Sullivan	1,311,926	70,634	91,148	21,596	+3,500	1,498,804	1.72	789	155	218	1,162	140	9.18
Vermillion	370,856	113,950	1,262	3,655	−2,102	487,621	1.52	328	46	82	456	158	6.78
Vigo	2,722,619	157,196	359,069	34,158	+6,364	3,279,406	1.55	1,219	207	348	1,774	212	8.72
Warren		4,441	411	507		5,359	2.26	18		3	21	193	1.32
Warrick	1,061,709	184,460	2,209	4,768	−1,386	1,251,760	1.24	305	222	178	705	184	9.66

Other counties (Gibson, Owen, Spencer, and Vanderburgh)	965, 948	159, 424	4, 897	17, 957	+998	1, 149, 224	1. 72	809	71	140	1, 020	123	9. 14
Total Indiana	14, 376, 418	1, 920, 025	475, 007	[4] 153, 217	+18, 105	16, 942, 772	1. 48	5, 338	2, 140	2, 288	9, 766	177	[5] 9. 79
IOWA													
Adams		17, 493	60	8		17, 561	$2. 63	78		12	90	136	1. 44
Appanoose	207, 041	134, 656	2, 745	309	−696	344, 055	2. 49	1, 197		141	1, 338	118	2. 19
Boone	169, 233	63, 325	14, 796	1, 433	−179	248, 608	3. 00	540		66	606	149	2. 76
Dallas	319, 238	62, 363	6, 883	1, 273	−120	389, 637	2. 69	596		43	639	196	3. 12
Greene		20, 554	124	130		20, 808	2. 69	43	11	12	66	87	3. 61
Guthrie		24, 185	15		+138	24, 338	2. 99	98		10	108	153	1. 47
Jasper		26, 699	740	114	+239	27, 792	2. 70	68	6	15	89	84	3. 72
Mahaska	122, 147	143, 045	1, 810	1, 151	+2, 628	270, 781	2. 04	87	135	63	285	163	5. 84
Marion	158, 762	365, 913	3, 921	1, 556	−466	529, 686	2. 11	536	95	92	723	183	4. 01
Monroe	53, 480	47, 706	1, 571	944	−89	103, 612	2. 12	256	7	38	301	111	3. 11
Page		35, 230	381			35, 611	2. 73	88		10	98	177	2. 05
Polk	74, 031	228, 158	3, 877	1, 350	+1, 504	308, 920	2. 71	654	5	56	715	137	3. 15
Van Buren		18, 114	224	17		18, 355	2. 63	26	7	6	39	189	2. 49
Wapello	53, 118	123, 111	907	834	+2, 960	180, 930	2. 14	258	24	54	336	140	3. 84
Warren	3, 753	61, 266	1, 181	1, 882	−1, 067	67, 015	2. 60	112	21	27	160	106	3. 88
Wayne		24, 028	202			24, 230	2. 31	89		13	102	168	1. 41
Webster		35, 979	100			36, 079	2. 73	59	5	9	73	147	3. 35
Other counties (Davis, Jefferson, Lucas, and Taylor)	248, 051	47, 014	3, 846	648	−20	299, 539	2. 33	435	6	42	483	163	3. 80
Total Iowa	1, 408, 854	1, 478, 839	43, 383	[4] 11, 649	+4, 832	2, 947, 557	2. 44	5, 220	322	709	6, 251	147	3. 20
KANSAS													
Crawford	1, 647, 911	70, 395	2, 048	8, 863	−3, 566	1, 725, 651	$1. 85	1, 009	307	298	1, 614	154	6. 92
Franklin		16, 337	223	100		16, 660	2. 64	41		6	47	180	1. 97
Labette		9, 616	20	1, 100		10, 736	2. 21	8	7	3	18	163	3. 65
Linn		16, 499	175	230		16, 904	1. 95	53	3	8	64	141	1. 87
Osage	1, 901	74, 118	2, 991	141		79, 151	2. 89	292	16	41	349	163	1. 39
Other counties (Bourbon, Cherokee, and Leavenworth)	761, 831	60, 827	2, 769	3, 142	−2, 980	825, 589	1. 87	369	192	205	766	239	4. 50
Total Kansas [6]	2, 411, 643	247, 792	8, 226	[4] 13, 576	−6, 546	2, 674, 691	1. 89	1, 772	525	561	2, 858	178	5. 25
KENTUCKY													
Eastern district:													
Bell	1, 488, 732	97, 261	24, 075	8, 731	+2, 097	1, 620, 896	$1. 76	2, 486		370	2, 856	167	3. 40
Boyd		25, 594	51	10		25, 655	1. 74	78		11	89	182	1. 58
Clay	125, 703	48, 334				174, 037	1. 87	379	6	55	440	200	1. 98
Floyd	4, 480, 998	1, 187	10, 782	17, 716	+6, 592	4, 517, 275	1. 84	4, 683		701	5, 384	186	4. 52

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*—Continued

KENTUCKY—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods): Underground	Surface: In strip pits	Surface: All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
Eastern district—Continued.													
Greenup		3,798				3,798	$1.38	18		3	21	77	2.34
Harlan	12,160,173	12,875	82,461	16,489	−10,986	12,261,012	1.95	12,035		1,563	13,598	197	4.57
Jackson		196,889	50	10,130	−1,814	205,255	1.78	400		62	462	195	2.27
Knott	430,554		1,766		+1,216	433,536	1.74	519		71	590	137	5.35
Knox	642,522	1,540	2,413	3,010	−1,301	648,184	1.72	829		84	913	239	2.98
Laurel	395	49,323	260	170		50,148	1.70	126		18	144	170	2.05
Lee		17,848	50	10		17,908	1.69	50		7	57	157	2.01
Letcher	3,740,035	3,659	27,913	1,589	−10,898	3,762,298	1.79	4,224		617	4,841	176	4.41
Perry	3,986,441	3,860	102,019	159	+3,268	4,095,747	1.77	4,068		614	4,682	162	5.41
Pike	4,052,152	19,837	207,575	3,078	−2,575	4,280,067	1.69	3,530		626	4,156	193	5.33
Rockcastle	200	23,598	30			23,828	1.43	48		7	55	159	2.73
Whitley	278,906	1,500	1,515	8,868	+1,588	292,377	2.11	597	2	103	702	159	2.62
Other counties [10]	1,693,641	92,304	50,253	14,396	+3,014	1,853,608	1.95	2,369		357	2,726	188	3.62
Total Eastern Kentucky	33,080,452	599,407	511,213	84,356	−9,799	34,265,629	1.85	36,439	8	5,269	41,716	185	4.43
Western district:													
Butler	290	10,906	90			11,286	1.69	44		6	50	135	1.67
Daviess		106,110	316	2,545		108,971	1.15	160		20	180	156	3.89
Henderson	14,342	77,577	1,315	10,442	+462	104,138	1.67	170		34	204	141	3.61
Hopkins	3,446,937	205,454	40,907	10,287	+4,560	3,708,145	1.37	2,609	70	535	3,214	161	7.16
McLean		8,780	30	85		8,895	1.36	21		3	24	129	2.88
Muhlenburg	2,204,354	63,136	12,847	36,315	+27,190	2,343,842	1.17	2,191		496	2,687	153	5.72
Ohio	224,194	26,530	3,574	1,253	−25	255,526	1.36	268		35	303	169	5.00
Union	478,116	83,657	19,692	16,379	+135	597,979	1.42	667		101	768	143	5.43
Webster	1,039,776	36,073	5,166	2,640	−145	1,083,510	1.27	1,252		157	1,409	136	5.66

Other counties (Christian and Hancock)	32,399	36,157	51	40	....	68,647	1.50	60	15	11	86	165	4.83
Total Western Kentucky	7,440,408	654,380	83,988	79,986	+32,177	8,290,939	1.30	7,442	85	1,398	8,925	153	6.09
Total Kentucky	40,520,860	1,253,787	595,201	[4] 164,342	+22,378	42,556,568	1.74	43,881	93	6,667	50,641	180	4.68
MARYLAND													
Allegany	653,486	188,256	5,672	738	−326	847,826	$2.12	1,201	....	145	1,346	188	3.35
Garrett	534,751	48,278	4,030	7,742	+101	594,902	1.92	856	....	149	1,005	166	3.57
Total Maryland	1,188,237	236,534	9,702	[4] 8,480	−225	1,442,728	2.04	2,057	....	294	2,351	178	3.44
MICHIGAN													
Bay	15,037	43,995	853	4,677	....	64,562	$3.99	249	....	18	267	87	2.79
Saginaw	4,147	100,219	2,604	14,207	−474	120,703	3.81	249	....	59	308	182	2.16
Other counties (Shiawassee and Tuscola)	103,031	151,126	4,703	7,833	+4,796	271,489	3.70	540	....	39	579	173	2.71
Total Michigan	122,215	295,340	8,160	[4] 26,717	+4,322	456,754	3.77	1,038	....	116	1,154	155	2.55
MISSOURI													
Adair	38,178	56,360	1,785	3,642	....	99,965	$1.76	286	....	44	330	125	2.43
Boone	....	14,131	....	260	....	14,391	2.17	17	21	8	46	113	2.76
Clay	....	89,874	3,366	2,030	....	95,270	2.93	348	....	38	386	163	1.52
Harrison	....	18,298	84	420	....	18,802	2.43	52	....	7	59	216	1.48
Henry	531,460	107,335	1,785	7,925	−2,251	646,254	1.72	32	148	111	291	211	[11] 10.50
Lafayette	167,285	76,769	3,778	3,305	+15	251,152	2.43	892	....	71	963	134	1.94
Linn	15,969	51,407	1,041	63	....	68,480	2.08	190	....	26	216	194	1.64
Putnam	....	31,116	140	22	....	31,278	2.07	141	....	20	161	114	1.70
Randolph	372,547	77,952	2,016	237	+1,308	454,060	1.87	267	46	79	392	207	5.60
Ray	31,907	98,601	3,551	310	−319	134,050	2.56	595	....	71	666	118	1.70
Vernon	11,594	43,033	346	2,905	−192	57,686	1.77	20	55	19	94	122	[11] 5.03
Other counties [12]	1,097,677	291,577	3,987	9,930	−1,009	1,402,162	1.70	295	402	192	889	189	[11] 8.36
Total Missouri [9]	2,266,617	956,453	21,879	[4] 31,049	−2,448	3,273,550	1.88	3,135	672	686	4,493	158	4.60

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*—Continued

MONTANA

County	Disposition of coal produced (net tons)						Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods)				Average number of full days mines were active	Tons of coal produced on active days per man-shift
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity		Underground	Surface: In strip pits	Surface: All others	Total		
Montana bituminous coal:													
Chouteau		5,597	30			5,627	$4.45	17		2	19	197	1.50
Custer		9,698	35			9,733	1.54	16		2	18	164	3.30
Hill		6,669	90			6,759	3.46	18		2	20	130	2.60
Musselshell	698,560	33,592	3,053	2,757	−15	737,947	1.89	460		170	630	149	7.88
Powder River		7,807	28			7,835	1.72	8	(6)	(6)	11	153	4.66
Other counties [13]	1,898,040	82,616	4,824	1,613	+1,042	1,988,135	1.28	515	(6)	(6)	685	186	15.57
Total bituminous coal	2,596,600	145,979	8,060	4,370	+1,027	2,756,036	1.46	1,034	(6)	(6)	1,383	168	11.87
Montana lignite:													
Roosevelt	(14)	(14)	(14)	(14)	(14)	8,706	1.47	16		5	21	144	2.88
Sheridan						14,609	1.60	16		8	24	205	2.96
Other counties (Custer, McCone, Richland, Valley, and Wibaux)						24,398	1.62	23	(6)	(6)	40	131	4.65
Total lignite	[14] 5,410	[14] 41,190	[14] 1,018	[14] 95		47,713	1.59	55	(6)	(6)	85	155	3.61
Total Montana	[14] 2,602,010	[14] 187,169	[14] 9,078	[4] [14] 4,465	+1,027	2,803,749	1.46	1,089	(6)	(6)	1,468	167	11.42

NEW MEXICO

County	Loaded for shipment by rail or water	Shipped by truck or wagon	Used by mine employees, etc.	Used at mine for power and heat or coke	Net changes in stocks	Total quantity	Average value per ton	Underground	In strip pits	All others	Total	Average number of full days mines were active	Tons per man-shift
Colfax	608,106	30,101	4,163	2,751	+286	645,407	$2.74	807		171	978	142	4.66
McKinley	352,668	53,146	5,174	26,454	+6,862	444,304	3.00	713		174	887	171	2.93

Sandoval	----------	5,378	10	75	----------	5,463	2.89	23	----------	3	26	209	1.00
Other counties (Bernalillo, Rio Arriba, San Juan, Santa Fe, and Socorro)	97,197	24,556	3,912	7,548	+1,673	134,886	2.84	256	----------	52	308	223	1.96
Total New Mexico	1,057,971	113,181	13,259	[4] 36,828	+8,821	1,230,060	2.85	1,799	----------	400	2,199	166	3.37
NORTH DAKOTA (LIGNITE)													
Adams						43,690	$1.10	47	----------	19	66	147	4.50
Burke						242,961	1.20	----------	68	39	107	153	[11] 14.80
Burleigh						227,504	1.25	25	29	26	80	188	[11] 15.12
Divide						168,928	1.19	5	33	20	58	256	[11] 11.39
Golden Valley						4,715	1.14	4	----------	3	7	103	6.57
Grant						19,129	1.36	16	----------	10	26	119	6.21
Hettinger						8,876	1.34	6	3	3	12	197	8.76
McLean	(14)	(14)	(14)	(14)	(14)	142,190	1.22	42	37	50	129	204	5.41
Mercer						576,610	1.12	159	65	67	291	199	9.95
Morton						18,108	1.40	12	2	11	25	178	4.06
Mountrail						10,297	1.40	6	6	5	17	165	3.67
Stark						95,983	.98	55	----------	6	61	248	6.35
Ward						458,449	1.21	147	50	67	264	191	[11] 9.09
Williams						36,776	1.25	27	7	14	48	128	5.99
Other counties (Billings, Bowman, Dunn, McKenzie, and Oliver)						18,277	1.29	9	5	9	23	172	4.62
Total North Dakota	[14] 1,522,676	[14] 403,763	[14] 136,281	[4] [14] 9,773	----------	2,072,493	1.18	560	305	349	1,214	189	9.04
OHIO													
Athens	1,564,374	51,067	5,253	16,302	+2,304	1,639,300	$1.81	2,259	----------	364	2,623	157	3.97
Belmont	4,797,493	196,921	33,944	10,407	−11,535	5,027,230	1.62	5,254	16	569	5,839	171	5.04
Carroll	111,074	310,526	2,444	2,742	−1,454	425,332	1.82	389	78	73	540	166	4.75
Columbiana	35,106	621,571	481	3,003	----------	660,161	1.47	305	92	108	505	203	6.45
Coshocton	16,202	210,462	900	666	----------	228,230	1.87	267	21	59	347	187	3.53
Gallia	100	29,767	----------	----------	----------	29,867	1.95	59		6	65	241	1.90
Guernsey	402,536	107,436	16,674	838	+53	527,537	1.60	469	----------	49	518	217	4.70
Harrison	2,518,041	37,591	965	27,586	−2,851	2,581,332	1.37	1,050	81	356	1,487	217	7.98
Hocking	138,662	90,015	389	362	−517	228,911	1.73	271	6	40	317	179	4.03
Holmes	----------	34,734	40	39	----------	34,813	2.12	54	6	9	69	214	2.35
Jackson	90,488	80,099	21,424	----------	+364	192,375	2.27	236	27	35	298	180	3.59
Jefferson	4,304,515	317,412	7,974	26,714	−4,777	4,651,838	1.55	3,024	297	567	3,888	187	6.39
Lawrence	100	72,136	25	51	----------	72,312	2.00	108		19	127	215	2.65
Mahoning	9,341	418,060	468	6,109	----------	433,978	1.80	150	93	40	283	193	7.94
Medina	----------	4,678	9	127	----------	4,814	2.16	14	----------	2	16	135	2.22
Meigs	59,135	106,831	5,003	15	----------	170,984	1.60	271	----------	36	307	177	3.14
Muskingum	678,806	235,783	79	315	+450	915,433	1.66	619	24	100	743	194	6.34
Perry	553,305	227,682	4,156	619	+2,199	787,961	1.74	1,398	15	185	1,598	124	3.96

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*—Continued

OHIO—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [3]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods): Underground	Surface: In strip pits	Surface: All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
Portage		46,871	413	693		47,977	$2.15	27	15	9	51	199	4.73
Stark		573,757	2,975	426	−233	576,925	1.86	274	131	68	473	184	6.63
Tuscarawas	65,236	751,225	68,050	1,047	+13	885,571	1.90	947	101	165	1,213	159	4.59
Vinton	1,500	101,291	246	80		103,117	1.96	65	47	18	130	172	4.62
Other counties (Morgan, Noble, Washington, and Wayne)	34,067	29,473	15			63,555	2.17	147		58	205	130	2.28
Total Ohio	15,380,081	4,655,388	171,927	[4] 98,141	−15,984	20,289,553	1.63	17,657	1,050	2,935	21,642	175	5.35

OKLAHOMA

County	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [3]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Underground	In strip pits	All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
Coal		17,824	97	20		17,941	$2.77	51		7	58	154	2.00
Craig		8,112	49	127		8,288	2.27		14	4	18	181	2.55
Latimer	4,016	2,638	25	115		6,794	2.59	19		5	24	103	2.74
LeFlore	212,133	5,038	382	1,546	+154	219,253	2.64	707		131	838	97	2.70
Muskogee	2,711	3,978	8	100		6,797	2.62	11	9	4	24	102	2.78
Okmulgee	211,691	18,245	187	850	+602	231,575	1.87	215		42	257	158	5.71
Pittsburg	136,982	16,834	501	5,122	+250	159,689	2.66	385		75	460	141	2.47
Tulsa	28,574	9,122	123	191		38,010	2.12	87	5	13	105	145	2.50
Other counties:													
Haskell and Sequoyah	73,284	922	89	1,020		75,315	2.00	35	31	24	90	182	4.59
Rogers and Wagoner	379,629	41,102	758	4,309	−1,898	423,900	1.73		85	73	158	224	[11] 11.99
Total Oklahoma	1,049,020	123,815	2,219	[4] 13,400	−892	1,187,562	2.11	1,510	144	378	2,032	133	4.39

PENNSYLVANIA (BITUMINOUS COAL)

Allegheny	10, 197, 634	1, 766, 064	918, 525	60, 580	−19, 893	12, 922, 910	$1. 89	11, 553	185	1, 633	13, 371	188	5. 14
Armstrong	2, 770, 939	51, 029	32, 468	340	−9, 107	2, 845, 669	1. 89	3, 107	10	364	3, 481	179	4. 57
Beaver	230, 338	419, 963	927	5, 457	+7, 690	664, 275	1. 79	153	156	136	445	200	7. 46
Bedford	59, 458	77, 179	183, 952	512	+626	321, 727	3. 45	483	--------	57	540	171	3. 48
Blair	78, 230	68, 750	892	164	+2, 212	150, 248	2. 27	364	--------	52	416	150	2. 41
Butler	289, 019	311, 597	5, 084	115	+572	606, 387	2. 03	1, 116	6	158	1, 280	154	3. 08
Cambria	12, 276, 600	388, 484	929, 218	[15] 173, 205	+17, 333	13, 784, 840	2. 18	17, 347	--------	2, 133	19, 480	178	3. 97
Center	287, 963	128, 947	9, 234	226	+13	426, 383	1. 92	719	--------	96	815	165	3. 17
Clarion	1, 196, 351	149, 834	20, 571	1, 015	+4	1, 367, 275	1. 75	1, 424	72	144	1, 640	188	4. 43
Clearfield	2, 672, 462	240, 886	12, 337	25, 211	−41, 318	2, 909, 578	2. 01	4, 582	110	540	5, 232	160	3. 49
Clinton	1, 789	39, 847	86	18	--------	41, 740	1. 97	76	--------	11	87	192	2. 50
Fayette	14, 218, 835	332, 375	83, 355	[15] 1, 031, 032	+7, 082	15, 672, 679	2. 21	14, 408	280	1, 774	16, 462	166	5. 72
Greene	3, 836, 123	10, 922	14, 953	14, 533	+62, 633	3, 939, 164	2. 21	3, 143	--------	553	3, 696	185	5. 78
Huntingdon	396, 378	66, 380	746	3, 906	−310	467, 100	2. 38	725	--------	90	815	183	3. 14
Indiana	5, 306, 785	48, 759	266, 183	[15] 202, 996	+2, 369	5, 827, 092	1. 80	5, 551	--------	676	6, 227	177	5. 29
Jefferson	1, 642, 079	92, 924	3, 398	2, 777	+2, 811	1, 743, 989	1. 97	2, 003	36	241	2, 280	177	4. 33
Lycoming	10, 231	45, 230	120	20	--------	55, 601	2. 21	100	--------	16	116	192	2. 50
Mercer	64, 024	154, 633	702	1, 201	−3, 039	217, 521	2. 14	253	45	65	363	151	3. 96
Somerset	4, 222, 224	89, 346	33, 652	55, 009	+634	4, 400, 865	2. 13	5, 710	--------	722	6, 432	160	4. 27
Tioga	170, 088	71, 440	722	4, 300	+390	246, 940	2. 43	321	33	63	417	184	3. 22
Venango	--------	51, 744	50	--------	--------	51, 794	1. 77	46	11	11	68	225	3. 38
Washington	14, 826, 013	315, 049	188, 498	28, 211	+127, 214	15, 484, 985	1. 94	14, 742	209	1, 620	16, 571	182	5. 12
Westmoreland	6, 211, 127	549, 759	143, 606	[15] 413, 181	+11, 761	7, 329, 434	1. 85	7, 252	38	1, 004	8, 294	173	5. 11
Other counties:													
Bradford, Cameron, Elk, Forest, Fulton, and Warren	733, 020	67, 824	3, 508	19, 077	+610	824, 039	2. 01	1, 147	16	194	1, 357	179	3. 39
Crawford and Lawrence	217, 831	65, 818	2, 344	344	−4, 459	281, 878	2. 72	407	12	42	461	201	3. 04
Total Pennsylvania	81, 915, 541	5, 604, 283	2, 855, 031	[15] 2, 043, 430	+165, 828	92, 584, 113	2. 03	96, 732	1, 219	12, 395	110, 346	176	4. 77

SOUTH DAKOTA (LIGNITE)

Dewey and Perkins	[14] 26, 959	[14] 20, 623	[14] 190	[14] 10	--------	47, 782	$1. 35	1	(6)	(6)	31	219	7. 03

TENNESSEE

Anderson	919, 439	43, 737	5, 207	7, 753	+1, 340	977, 476	$2. 02	1, 185	--------	304	1, 489	178	3. 70
Campbell	1, 310, 262	32, 038	22, 461	1, 162	+1, 303	1, 367, 226	2. 06	1, 909	--------	264	2, 173	175	3. 60
Claiborne	1, 181, 731	23, 250	12, 142	1, 509	+3, 944	1, 222, 576	1. 87	1, 520	--------	194	1, 714	170	4. 19
Cumberland	--------	9, 272	--------	--------	--------	9, 272	1. 85	21	--------	2	23	168	2. 41
Hamilton	--------	23, 707	--------	--------	--------	23, 707	1. 82	55	--------	8	63	138	2. 73
Putnam	12, 372	9, 320	106	153	--------	21, 951	1. 88	93	--------	14	107	93	2. 21
Scott	101, 752	22, 233	746	2, 178	--------	126, 909	1. 88	187	(6)	(6)	238	167	3. 19
White	--------	6, 395	40	--------	--------	6, 435	1. 92	16	--------	2	18	169	2. 12

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties—Continued*

TENNESSEE—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity	Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods): Underground	Surface: In strip pits	Surface: All others	Total	Average number of full days mines were active	Tons of coal produced on active days per man-shift
Other counties:													
Bledsoe, Grundy, Marion, Rhea, Sequatchie, and Van Buren	805,756	109,230	10,270	2,432	−3,586	924,102	$2.06	1,216		225	1,441	186	3.44
Fentress, Morgan, and Overton	449,035	32,454	4,732	19,456	+150	505,827	1.53	575	(6)	(6)	659	211	3.64
Total Tennessee	4,780,347	311,636	55,704	[4] 34,643	+3,151	5,185,481	1.95	6,777	(6)	(6)	7,925	178	3.68

TEXAS

County	Loaded for shipment by rail or water	Shipped by truck or wagon	Used by mine employees, etc.	Used at mine for power and heat, etc.	Net changes in stocks	Total quantity	Average value per ton	Underground	In strip pits	All others	Total	Average number of full days mines were active	Tons per man-shift
Texas bituminous coal:													
Palo Pinto, Webb, and Wise	9,554	6,073	6	463	+163	16,259	$3.23	175		61	236	44	1.55
Total bituminous coal	9,554	6,073	6	463	+163	16,259	3.23	175		61	236	44	1.55
Texas lignite:													
Bastrop, Henderson, Milam, Titus, and Wood	[14] 793,647	[14] 7,914	[14] 4,478	[14] 4,019		810,058	1.07	475	(6)	(6)	559	236	6.14
Total lignite	[14] 793,647	[14] 7,914	[14] 4,478	[14] 4,019		810,058	1.07	475	(6)	(6)	559	236	6.14
Total Texas	[14] 803,201	[14] 13,987	[14] 4,484	[4] [14] 4,482	+163	826,317	1.12	650	(6)	(6)	795	179	5.80

UTAH

Carbon	2,353,418	209,951	14,919	[16] 17,181	+6,405	2,601,874	$2.15	1,514		563	2,077	172	7.28
Summit	3,712	25,782	50			29,544	1.98	35		9	44	199	3.37
Other counties (Emery, Grand, Iron, Sevier, and Uintah)	541,339	111,670	7,870	3,906	−11,299	653,486	2.07	312	(6)	(6)	423	166	9.33
Total Utah	2,898,469	347,403	22,839	[16] 21,087	−4,894	3,284,904	2.14	1,861	(6)	(6)	2,544	171	7.53

VIRGINIA

Buchanan	4,278,510	2,574	7,049	285	−7,642	4,280,776	$1.78	3,457		389	3,846	192	5.79
Dickenson	1,544,362		6,512	821	+173	1,551,868	1.68	1,280		163	1,443	250	4.29
Lee	1,141,640	38,446	12,210	2,292	+1,512	1,196,100	2.03	1,662		188	1,850	169	3.83
Tazewell	2,669,998	51,956	23,592	10,467	+1,941	2,757,984	1.92	2,869		478	3,347	191	4.32
Wise	2,546,545	62,890	18,930	[17] 298,056	+14,159	2,940,580	1.86	3,441		387	3,828	165	4.65
Other counties:													
Montgomery and Pulaski	142,747	9,320		900		152,967	1.96	313		79	392	163	2.39
Russell and Scott	586,438	56,522	5,693	4,613	−2,567	650,699	1.98	792		127	919	168	4.21
Total Virginia	12,910,240	221,738	73,986	[17] 317,434	+7,576	13,530,974	1.85	13,814		1,811	15,625	186	4.66

WASHINGTON

King	345,988	273,247	5,332	853	−4,218	621,202	$3.29	683	(6)	(6)	899	206	3.36
Lewis	9,129	24,221	8	335		33,693	2.54	43		7	50	162	4.15
Pierce	19,311	19,531	248	123		39,213	3.46	75		14	89	180	2.45
Other counties (Kittitas, Thurston, and Whatcom)	877,813	76,519	45,715	14,600	−18,313	996,334	3.00	954		283	1,237	182	4.44
Total Washington	1,252,241	393,518	51,303	[4] 15,911	−22,531	1,690,442	3.11	1,755	(6)	(6)	2,275	191	3.90

See footnotes at end of table.

TABLE 45.—*Production, value, employment, days active, and output per man-shift at bituminous coal and lignite mines in the United States in 1939, by States and counties*—Continued

WEST VIRGINIA

County	Disposition of coal produced (net tons)						Average value per ton [3]	Average number of wage earners and working proprietors on active days (excluding shut-down periods)				Average number of full days mines were active	Tons of coal produced on active days per man-shift
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines [2]	Used at mine for power and heat or made into beehive coke at mine	Net changes in stocks of coal at mines Jan. 1, 1939, to Jan. 1, 1940	Total quantity		Underground	Surface: In strip pits	Surface: All others	Total		
Barbour	1,423,049	1,069	1,230	106	+2,264	1,427,718	$1.64	1,351		175	1,526	180	5.19
Boone	3,221,044	5,117	13,336	1,247	+6,717	3,247,461	1.79	2,872		510	3,382	185	5.18
Brooke	469,134	215,274	847,693	98	+1,189	1,533,388	1.69	772	184	164	1,120	189	7.25
Fayette	10,788,947	23,500	172,860	[18] 147,039	−45,406	11,086,940	2.02	10,851		1,382	12,233	198	4.59
Greenbrier	1,419,581	54,146	9,271	393	+4,088	1,487,479	1.86	1,543		165	1,708	177	4.91
Hancock	65,854	189,029	1,758	106		256,747	1.12	54	53	18	125	222	9.23
Harrison	3,461,654	32,423	46,118	4,303	−2,464	3,542,034	1.51	2,305		419	2,724	176	7.37
Kanawha	6,282,200	35,442	53,463	4,778	−37,979	6,337,904	1.76	6,195		671	6,866	186	4.95
Logan	14,448,125	3,848	97,580	[18] 27,583	+259,935	14,837,071	1.61	9,233		1,926	11,159	191	6.97
McDowell	20,118,827	39,767	123,567	120,914	−73,445	20,329,630	1.84	16,412		3,237	19,649	186	5.58
Marion	7,700,189	224,857	10,575	41,968	+1,189	7,978,778	1.60	5,430		742	6,172	195	6.61
Mason	18,973	49,204	359	1,325	+1,388	71,249	1.68	171		23	194	126	2.98
Mercer	2,979,100	7,903	21,718	819	−141	3,009,399	1.81	3,044		612	3,656	185	4.46
Mineral	138,447	33,842	473	193		172,955	2.39	409		35	444	160	2.44
Mingo	3,020,439	2,655	22,231	24	+3,296	3,048,645	1.61	2,771		461	3,232	176	5.35
Monongalia	6,527,641	56,587	19,286	272	+14,916	6,618,702	1.36	3,354		731	4,085	194	8.35
Nicholas		57,133	47	39		57,219	1.50	99		15	114	162	3.10
Preston	513,131	13,670	73,348	[18] 12,540		612,689	1.75	772	32	137	941	172	3.79
Raleigh	13,006,884	45,238	112,077	51,211	−8,516	13,206,894	1.88	11,677		1,831	13,508	194	5.04
Randolph	954,482	43,835	4,922	13,442	−2,179	1,014,502	1.88	1,046		213	1,259	193	4.19
Taylor	397,967	19,785	928	13		418,693	1.63	518		60	578	145	5.01
Upshur	58,026	9,869	37	508	+120	68,560	1.48	77		27	104	124	5.31
Wayne		26,897				26,897	1.66	35		5	40	202	3.33
Wyoming	2,703,058	7,366	17,210	17,652	−999	2,744,287	2.01	2,797		378	3,175	202	4.27

Other counties:													
Braxton, Gilmer, Lewis, and Webster	1,019,124	19,140	22,104	2,137	+653	1,063,158	2.09	1,092		183	1,275	175	4.76
Clay and Putnam	1,499,513	12,744	25,297	23,782	−7,614	1,553,722	1.88	1,377		193	1,570	230	4.81
Grant and Tucker	469,459	31,839	5,751	19,152	+2,695	528,896	2.13	527		64	591	202	4.43
Marshall and Ohio	1,699,745	248,004	123,804	2,883	+5,881	2,080,317	1.69	1,626		177	1,803	235	4.91
Total West Virginia	104,404,593	1,510,183	1,827,043	[18] 494,527	+125,588	108,361,934	1.76	88,410	269	14,554	103,233	190	5.51
WYOMING													
Converse		15,719				15,719	$1.95	2	12	3	17	173	5.34
Hot Springs	37,449	20,956	450	3	+503	59,361	3.02	110		26	136	136	3.20
Other counties [19]	4,969,304	160,607	54,262	98,919	+15,117	5,298,209	1.99	2,835	41	728	3,604	210	7.02
Total Wyoming	5,006,753	197,282	54,712	[4] 98,922	+15,620	5,373,289	2.00	2,947	53	757	3,757	207	6.92

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mines to points of use by conveyor, chute, or aerial tramway.

[3] Value of all coal produced, f. o. b. mine or cleaning plant, excluding selling cost. The value of cleaned coal, rather than that of raw coal, was used in cases of operations that cleaned coal.

[4] No coal was made into beehive coke at mines in 1939.

[5] Includes 97,591 tons made into beehive coke at mines in Las Animas County, Colo., in 1939.

[6] Not shown separately to avoid disclosure of individual operations.

[7] "Other counties" in Illinois include Adams, Bond, Bureau, Christian, Clinton, Crawford, Edgar, Greene, Hancock, Henry, Jackson, Jefferson, Logan, Marion, Mason, Morgan, Scott, Warren, Washington, White, Will, and Woodford.

[8] Much of the output of the State obtained from strip pits or by use of loading machines, in which types of operations production per man-shift is large.

[9] Production of Home Riverside and Alston mines is credited to Missouri rather than to Kansas.

[10] "Other counties" in Eastern Kentucky include Breathitt, Carter, Elliott, Johnson, Lawrence, McCreary, Magoffin, Martin, Morgan, Owsley, Pulaski, and Wolfe.

[11] Output obtained chiefly from strip pits in which production per man-shift is large.

[12] Other counties in Missouri include Barton, Bates, Callaway, Chariton, Clark, Dale, Daviess, Grundy, Howard, Jasper, Johnson, Lincoln, Macon, Monroe. Morgan, Platte, Ralls, and Warren.

[13] "Other counties" in Montana (bituminous coal) include Blaine, Carbon, Cascade, Fergus, Flathead, Gallatin, Judith Basin, Park, Phillips, Pondera, and Rosebud.

[14] Estimate made from various sources on disposition of lignite has been included for comparative purposes; the lignite schedule did not ask for this break-down. Data by counties not available.

[15] Includes coal made into beehive coke at mines in following counties in Pennsylvania in 1939: Cambria, 45,545 tons; Fayette, 997,104 tons; Indiana, 131,001 tons; and Westmoreland, 380,529 tons—State total, 1,554,179 tons.

[16] Includes 13,825 tons made into beehive coke at mines in Carbon County, Utah, in 1939.

[17] Includes 292,152 tons made into beehive coke at mines in Wise County, Va., in 1939.

[18] Includes coal made into beehive coke at mines in following counties in West Virginia in 1939: Fayette, 119,495 tons; Logan, 154 tons: and Preston, 12,079 tons—State total, 131,728 tons.

[19] "Other counties" in Wyoming include Campbell, Carbon, Crook, Fremont, Johnson, Lincoln, Natrona, Sheridan, Sweetwater, and Uinta.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface: In strip pits	Surface: All others	Total			
ALABAMA													
Bibb	713,328	47,779	3,226	16,590	780,923	$2.62	1,139	14	216	1,369	218	298,837	2.61
Blount	103,840	40,075	596	1,958	146,469	2.39	304	23	55	382	204	77,935	1.88
Cherokee	----------	9,626	----------	----------	9,626	1.70	16	----------	4	20	192	3,840	2.51
Cullman	----------	63,157	207	----------	63,364	2.51	162	----------	23	185	185	34,185	1.85
Etowah	14,699	14,129	----------	----------	28,828	2.11	74	----------	12	86	164	14,118	2.04
Jefferson	9,001,797	286,541	63,431	28,885	9,380,654	2.28	11,676	4	1,880	13,560	229	3,100,505	3.03
Marion	262,469	54,902	1,611	74	319,056	3.06	532	11	91	634	212	134,697	2.37
Shelby	400,643	100,731	2,874	1,568	505,816	2.85	790	----------	152	942	232	218,351	2.32
Tuscaloosa	61,481	51,939	45	----------	113,465	2.30	282	----------	41	323	154	49,795	2.28
Walker	2,741,500	128,233	44,862	1,862	2,916,457	2.27	3,453	42	566	4,061	190	771,849	3.78
Winston	1,691	10,487	----------	----------	12,178	2.42	39	----------	9	48	147	7,038	1.73
Other counties (De Kalb, Fayette, Jackson, and St. Clair)	951,115	46,804	15,012	34,396	1,047,327	2.32	1,601	----------	265	1,866	228	425,041	2.46
Total Alabama	14,252,563	854,403	131,864	[4] 85,333	15,324,163	2.33	20,068	94	3,314	23,476	219	5,136,191	2.98
ALASKA													
Total Alaska	170,174	----------	----------	[4] 3,670	173,844	$3.49	70	----------	28	98	322	31,541	5.51
ARIZONA, IDAHO, AND OREGON													
Total Arizona, Idaho, and Oregon	----------	16,816	67	[4] 19	16,902	$3.32	37	----------	9	46	210	9,663	1.75

ARKANSAS

Franklin	115,770	7,261	529	1,909	125,469	$3.65	276	25	44	345	160	55,237	2.27
Johnson	162,972	18,418	137	2,979	184,506	3.05	467		115	582	122	71,065	2.60
Logan	443,154	4,251	1,152	7	448,564	3.94	1,216		224	1,440	128	184,256	2.43
Sebastian	569,813	37,289	319	2,330	609,751	2.93	1,048	33	203	1,284	141	181,420	3.36
Other counties (Pope and Scott)	82,979	1,864	172	306	85,321	3.61	187		37	224	159	35,643	2.39
Total Arkansas	1,374,688	69,083	2,309	[4] 7,531	1,453,611	3.36	3,194	58	623	3,875	136	527,621	2.76

COLORADO

Boulder	206,248	402,307	6,197	7,804	622,556	$2.90	573		102	675	240	161,861	3.85
Delta	33,380	26,961	398	4,968	65,707	2.48	45		22	67	176	11,793	5.57
El Paso	45,505	162,464	37,626	4,839	250,434	2.59	181		42	223	228	50,758	4.93
Fremont	151,621	358,912	3,117	2,106	515,756	2.71	686		141	827	184	151,782	3.40
Garfield	9,797	24,518	50	560	34,925	2.47	27		8	35	221	7,735	4.52
Gunnison	577,652	20,933	9,317	11,347	619,249	2.25	478		114	592	188	111,151	5.57
Huerfano	677,276	70,294	3,614	1,949	753,133	2.56	792		169	961	190	182,160	4.13
Jefferson	105,054	40,535	1,132	780	147,501	2.30	113		23	136	211	28,671	5.14
La Plata	10,171	18,739	236		29,146	2.06	31		7	38	236	8,977	3.25
Las Animas	1,076,914	56,423	6,837	[5] 112,158	1,252,332	2.28	1,436		212	1,648	195	320,636	3.91
Mesa	25,597	40,145	564	3,358	69,664	2.45	68		21	89	201	17,931	3.89
Moffat	25,770	20,382	2,010		48,162	2.10	20		9	29	220	6,381	7.55
Montezuma		4,298			4,298	2.92	8		3	11	162	1,786	2.41
Montrose		38,920			38,920	3.11	39		3	42	285	11,988	3.25
Routt	844,233	17,994	13,882	33,833	909,942	2.74	922		282	1,204	141	169,325	5.37
Weld	848,371	313,578	12,479	23,157	1,197,585	2.51	1,026		182	1,208	184	221,723	5.40
Other counties:													
Archuleta, Pitkin, and Rio Blanco	341	6,754	599		7,694	2.26	9		4	13	189	2,454	3.14
Elbert, Jackson, and Larimer	10,308	11,165		265	21,738	2.41	9	23	6	38	172	6,535	3.33
Total Colorado	4,648,238	1,635,322	98,058	[6] 207,124	6,588,742	2.53	6,463	23	1,350	7,836	188	1,473,647	4.47

GEORGIA

Total Georgia	35,082	5,531	1,016	[4] 678	42,307	$2.38	96		34	130	217	28,248	1.50

See footnotes at end of table.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface: In strip pits	Surface: All others	Total			
ILLINOIS													
Bureau	1.576	58,369	2,944	2,884	65,773	$3.13	231		17	248	123	30,461	2.16
Christian	5,057,283	159,224	3,997	17,736	5,238,240	1.49	1,820		580	2,400	197	473,174	11.07
Clinton	54,002	96,721	2,952	10,245	163,920	1.71	255		36	291	128	37,126	4.42
Edgar	11,362	26,131	145	2,558	40,196	1.99	48	21	23	92	95	8,711	4.61
Franklin	8,781,555	88,548	41,611	150,367	9,062,081	1.76	4,866		1,488	6,354	150	955,593	9.48
Fulton	3,643,419	521,590	5,857	13,953	4,184,819	1.57	628	268	547	1,443	210	302,883	13.82
Gallatin	2,821	51,188	15	1,967	55,991	1.72	61		19	80	205	16,423	3.41
Grundy		111,133	1,478	2,590	115,201	3.12	140	13	24	177	151	26,707	4.31
Henry	604,557	110,843	1,749	940	718,089	1.79	224	71	110	405	216	87,665	8.19
Jackson	1,865,510	111,649	3,499	4,804	1,985,462	1.71	569	89	216	874	251	219,420	9.05
Knox	544,368	202,480	2,33[illegible]	6,653	755,839	1.80	223	53	99	375	218	81,858	9.23
La Salle	111,565	306,360	13,871	554	432,350	2.73	455	88	93	636	203	129,105	3.35
Livingston		18,013	285	528	18,826	2.91	26	6	6	38	172	6,530	2.88
Macoupin	3,292,293	247,282	31,717	136,910	3,708,202	1.42	2,008		466	2,474	193	477,667	7.76
Madison	944,891	691,019	14,527	66,958	1,717,395	1.57	1,403		262	1,665	167	278,343	6.17
Menard		133,587	842	3,680	138,109	2.05	157		22	179	216	38,602	3.58
Mercer		24,994	181	375	25,550	2.72	49		8	57	162	9,237	2.77
Peoria	425,733	461,104	3,295	2,615	892,747	1.97	1,265	9	133	1,407	129	181,466	4.92
Perry	3,325,425	85,692	27,747	35,783	3,474,647	1.44	772	365	476	1,613	171	276,178	12.58
Randolph	1,092,464	85,689	5,024	23,047	1,206,224	1.45	340	51	199	590	168	98,906	12.20
Rock Island		13,628	198	50	13,876	3.19	38		5	43	151	6,496	2.14
St. Clair	683,239	1,444,558	132,456	45,468	2,305,721	1.67	1,774	108	363	2,245	141	317,471	7.26
Saline	4,270,790	72,144	8,972	46,338	4,398,244	1.84	2,020	160	597	2,777	176	489,153	8.99
Sangamon	1,579,677	606,006	14,754	20,692	2,221,129	1.87	2,610		324	2,934	151	443,907	5.00
Schuyler	949	55,361	20	1,304	57,634	2.11	70	11	23	104	196	20,371	2.83
Shelby		7,504		87	7,591	3.88	42		5	47	120	5,654	1.34
Stark		15,866		60	15,926	2.35	36		7	43	153	6,567	2.43
Tazewell	38,038	132,304	770	668	171,780	2.10	300		37	337	156	52,567	3.27
Vermilion	1,681,535	385,200	61,258	12,338	2,140,331	1.86	2,018	41	261	2,320	170	395,321	5.41

Wabash		4,907	60	100	5,067	2.04	21		5	26	132	3,434	1.48
Washington	186,108	84,524	57	11,016	281,705	1.69	245		58	303	148	44,865	6.28
Williamson	1,502,608	667,570	7,089	33,509	2,210,776	1.59	1,249	69	396	1,714	159	272,373	8.12
Other counties [6]	2,103,593	576,365	17,137	83,894	2,780,989	1.95	1,104	306	457	1,867	174	325,124	8.55
Total Illinois	41,805,361	7,657,553	406,845	[4] 740,671	50 610,430	1.69	27,067	1,729	7,362	36,158	169	6,119,358	[7] 8.27
INDIANA													
Clay	850,636	499,483	1,196	7,626	1,358,941	$1 85	141	414	280	835	168	140,650	9.66
Daviess		67,545	505	1,292	69,342	2.12	52	10	15	77	209	16,071	4.31
Dubois		8,739		12	8,751	1.67	13		4	17	184	3,124	2.80
Fountain	10,750	47,082	5	652	58,489	2.13	14	25	24	63	130	8,163	7.17
Gibson	806,383	146,641	24	20,667	973,715	1.73	454		94	548	149	81,845	11.90
Greene	2,063,947	164,211	1,979	17,336	2,247,473	1.57	338	222	369	929	199	184,490	12.18
Knox	2,074,266	363,696	8,072	20,580	2,466,614	1.44	922	24	317	1,263	228	287,932	8.57
Owen	23,084	7,764	144		30,992	1.44	5	24	18	47	61	2,879	10.76
Parke		140,249	391	3,259	143,899	2.36	197	9	41	247	192	47,337	3.04
Perry		29,821	45	15	29,881	1 54	32		8	40	223	8,936	3.34
Pike	3,486,559	69,961	6,456	17,920	3,580,896	1.26	114	449	500	1,063	191	203,258	17.62
Spencer	67,878	23,721	102	90	91,791	2 21	14	24	31	69	174	11,976	7.66
Sullivan	1,514,405	94,177	3,611	25,894	1,638,087	1.83	782	100	251	1,133	161	182,616	8.97
Vermillion	439,788	119,502	864	2,439	562,593	1.61	300	57	112	469	172	80,755	6.97
Vigo	3,262,848	214,990	401,790	23,766	3,903,394	1.55	1,268	116	492	1,876	217	406,608	9.60
Warren		4,396	500	920	5,816	2.15	14		3	17	189	3,215	1.81
Warrick	1,371,312	220,749	745	4,631	1,597,437	1.28	301	277	242	820	152	124,754	12.80
Other counties (Martin and Vanderburgh)	51,145	49,316			100,461	1.29	124		18	142	145	20,556	4.89
Total Indiana	16,023,001	2,272,043	426,429	[4] 147,099	18,868,572	1.53	5,085	1,751	2,819	9,655	188	1,815,165	[7] 10.39

See footnotes at end of table.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity	Average value per ton [3]	Average number of employees: Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines were active	Number of man-days worked	Average tons per man per day
IOWA													
Adams		19,148	30	82	19,260	$3.29	105		15	120	150	17,950	1.07
Appanoose	240,854	181,762	4,134	252	427,002	2.49	1,228		154	1,382	132	182,755	2.34
Boone	216,690	83,709	6,286	2,159	308,844	3.05	540		49	589	195	114,759	2.69
Dallas	256,692	85,094	6,268	1,305	349,359	2.64	661		41	702	159	111,912	3.12
Greene		19,235	259	537	20,031	3.09	39	7	5	51	109	5,550	3.61
Guthrie		25,376	215	15	25,606	3.68	137		14	151	140	21,143	1.21
Jasper		46,050	778	150	46,978	2.71	60	12	20	92	149	13,733	3.42
Lucas	167,062	23,197	2,970	1,219	194,448	2.22	256		24	280	165	46,305	4.20
Mahaska	179,533	171,117	1,362	1,617	353,629	2.05	67	159	78	304	170	51,773	6.83
Marion	131,351	403,535	3,252	235	538,373	2.08	481	97	112	690	173	119,638	4.50
Monroe	87,015	104,204	1,349	1,534	194,102	2.63	267	6	54	327	171	55,796	3.48
Page		40,136	433	30	40,599	2.98	129		19	148	143	21,230	1.91
Polk	88,285	261,310	8,135	1,610	359,340	2.89	585	5	64	654	179	117,065	3.07
Van Buren		23,699	140	87	23,926	2.70	23	19	13	55	149	8,176	2.93
Wapello	53,983	121,011	1,000	1,098	177,092	2.02	172	29	54	255	166	42,373	4.18
Warren	2,731	72,705	911	1,952	78,299	2.92	105	15	38	158	116	18,292	4.28
Wayne		24,295	99		24,394	2.32	98		14	112	132	14,805	1.65
Webster		22,818	55	5	22,878	2.77	58	4	13	75	119	8,920	2.56
Other counties (Davis, Jefferson, Keokuk, and Taylor)	202	26,737	60	18	27,017	2.77	50	17	9	76	175	13,303	2.03
Total Iowa	1,424,398	1,755,138	37,736	[4] 13,905	3,231,177	2.49	5,061	370	790	6,221	158	985,478	3.28
KANSAS													
Bourbon	129,926	21,789	141	1,378	153,234	$1.87		37	31	68	192	13,024	11.77
Cherokee	473,568	41,702	2,607	1,036	518,913	1.87	55	62	149	266	159	42,180	12.30
Crawford	1,865,607	118,189	5,489	4,755	1,994,040	1.89	894	290	338	1,522	188	285,889	6.97
Labette		15,513		900	16,413	2.40		18	3	21	156	3,284	5.00
Linn	695,074	20,636	239	305	716,254	1.64	40	54	81	175	228	39,960	17.92
Osage	1,469	101,151	1,973		104,593	3.01	308	13	29	350	181	63,347	1.65
Other counties (Franklin and Leavenworth)	60,812	14,693			75,505	2.08	304		108	412	250	103,185	.73
Total Kansas [5]	3,226,456	333,673	10,449	[4] 8,374	3,578,952	1.88	1,601	474	739	2,814	196	550,869	[6] 6.50

KENTUCKY

Eastern district:														
Bell	2,142,451	144,671	14,862	6,125	2,308,109	$1.87	2,839		390	3,229	199	641,219	3.60
Boyd		35,092	311	17	35,420	1.88	107		19	126	195	24,610	1.44
Breathitt	1,930	1,110	40,134		43,174	2.18	114		13	127	144	18,277	2.36
Carter	10,559	68,271	407	1,825	81,062	2.03	116		34	150	235	35,215	2.30
Clay	175,320	70,274	7,594		253,188	1.66	549		125	674	176	118,637	2.13
Floyd	5,153,920	11,468	11,694	18,762	5,195,844	1.98	4,574		731	5,305	208	1,101,415	4.72
Harlan	14,723,168	25,666	81,403	9,780	14,840,017	2.06	13,821		1,736	15,557	231	3,592,227	4.13
Jackson		236,093		[10] 6,106	242,199	1.84	393		66	459	242	110,900	2.18
Johnson	821,596		5,995	1,574	829,165	2.29	952		112	1,064	226	240,888	3.44
Knott	431,801	6,205	1,771		439,777	1.84	447		74	521	172	89,715	4.90
Knox	640,350	20,572	3,205	2,500	666,627	1.80	860		136	996	244	242,724	2.75
Laurel		98,456	690	976	100,122	1.95	156	7	63	226	197	44,613	2.24
Lee		19,355	20		19,375	1.86	63		14	77	156	12,039	1.61
Letcher	4,214,610	10,783	28,789	541	4,254,723	1.90	4,317		480	4,797	207	995,023	4.28
McCreary	802,385	3,540	11,363		817,288	2.01	1,035		150	1,185	200	237,442	3.44
Perry	4,525,881	8,586	112,337	140	4,646,944	1.87	4,413		687	5,100	176	897,741	5.18
Pike	4,535,071	24,266	231,999	1,863	4,793,199	1.76	3,686		627	4,313	209	900,542	5.32
Pulaski		45,375	42		45,417	1.80	109		27	136	136	18,430	2.46
Rockcastle		24,815			24,815	1.95	58		13	71	161	11,400	2.18
Whitley	343,432	30,789	2,924	9,055	386,200	2.11	732	14	102	848	168	142,259	2.71
Wolfe		15,433	15	2	15,450	1.88	26		5	31	180	5,580	2.77
Other counties [11]	292,741	14,647	172	5	307,565	1.86	327		60	387	153	59,260	5.19
Total Eastern Kentucky	38,815,215	915,467	555,727	[10] 59,271	40,345,680	1.96	39,694	21	5,664	45,379	210	9,540,156	4.23
Western district													
Butler		22,297	63		22,360	1.69	60		14	74	142	10,478	2.13
Christian	20,250	28,651	100	200	49,201	1.28	67	4	13	84	147	12,354	3.98
Daviess		121,293	327	1,877	123,497	1.59	192		39	231	156	36,122	3.42
Edmonson		4,923	41		4,964	1.86	10		2	12	160	1,920	2.59
Hancock		11,308	20		11,328	1.60	28		4	32	173	5,520	2.05
Henderson	10,445	96,792	781	8,496	116,514	1.69	169		40	209	152	31,666	3.68
Hopkins	3,437,653	301,061	38,030	7,282	3,784,026	1.43	2,540	75	654	3,269	159	518,721	[7] 7.29
McLean		8,111			8,111	1.36	9		3	12	152	1,820	4.46
Muhlenberg	2,601,030	158,824	16,693	41,820	2,818,367	1.33	2,505		480	2,985	157	469,905	6.00
Ohio	100,522	41,388	2,324	227	144,461	1.31	285		63	348	99	34,426	4.20
Union	542,997	122,040	3,489	19,421	687,947	1.38	645		117	762	159	120,898	5.69
Webster	973,371	36,170	547	14,360	1,024,448	1.33	1,238		161	1,399	145	202,447	5.06
Total Western Kentucky	7,686,268	952,858	62,415	93,683	8,795,224	1.39	7,748	79	1,590	9,417	154	1,446,277	6.08
Total Kentucky	46,501,483	1,868,325	618,142	[10] 152,954	49,140,904	1.85	47,442	100	7,254	54,796	200	10,986,433	4.47

See footnotes at end of table.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface: In strip pits	Surface: All others	Total			
MARYLAND													
Allegany	713,685	252,815	6,362	842	973,704	$2.18	1,191	--------	156	1,347	209	280,856	3.47
Garrett	462,893	58,571	4,448	3,817	529,729	1.98	863	--------	129	992	145	144,080	3.68
Total Maryland	1,176,578	311,386	10,810	[4] 4,659	1,503,433	2.11	2,054	--------	285	2,339	182	424,936	3.54
MICHIGAN													
Saginaw	9,274	82,020	2,652	11,794	105,740	$4.01	235	--------	43	278	168	46,608	2.27
Other counties (Bay, Shiawassee, and Tuscola)	93,808	192,038	6,143	12,440	304,429	3.84	538	--------	54	592	197	116,483	2.61
Total Michigan	103,082	274,058	8,795	[4] 24,234	410,169	3.88	773	--------	97	870	187	163,091	2.51
MISSOURI													
Adair	17,182	51,019	933	2,717	71,851	$2.09	162	--------	28	190	129	24,458	2.94
Barton	152,583	28,306	113	1,480	182,482	1.94	--------	68	27	95	135	12,824	[9] 14.23
Bates	85,601	21,773	199	2,790	110,363	1.65	18	74	23	115	121	13,951	[9] 7.91
Boone	--------	15,459	15	342	15,816	2.22	15	13	7	35	124	4,332	3.65
Callaway	--------	153,562	460	25	154,047	2.14	11	37	25	73	252	18,422	[9] 8.36
Clay	--------	140,748	1,790	3,353	145,891	2.88	100	--------	39	439	172	75,780	1.93
Harrison	--------	22,831	150	470	23,451	2.69	56	--------	10	66	226	14,980	1.57
Henry	508,451	148,482	381	9,884	667,198	1.78	50	209	105	364	199	72,481	[9] 9.20
Lafayette	143,094	104,396	4,890	2,512	254,892	2.52	711	21	75	807	166	133,742	1.91
Linn	14,228	72,120	1,469	79	87,896	2.30	199	--------	20	219	257	56,376	1.56

Macon	401,348	61,376	9,380	1,726	473,830	1.76	136	49	66	261	201	50,573	[9] 9.37
Putnam		37,954	397	10	38,361	1.84	144		21	165	120	19,780	1.94
Ralls		21,452			21,452	2.47	43	7	10	60	201	12,040	1.78
Randolph	400,066	107,819	430	419	508,634	1.88	210	42	84	336	210	70,576	[9] 7.21
Ray	19,039	155,358	2,828	913	178,138	2.76	671		87	758	124	93,906	1.90
Vernon	19,024	48,732	257	3,270	71,283	1.74	15	45	13	73	155	11,339	[9] 6.20
Other counties [12]		89,190	297	1,669	91,156	2.45	79	53	44	176	180	33,338	2.73
Total Missouri [8]	1,760,616	1,280,577	23,989	[4] 31,559	3,096,741	2.04	2,920	618	684	4,222	170	718,755	4.31
MONTANA													
Montana bituminous coal:													
Carbon	350,226	35,451	2,750	476	388,903	$1.95	170		84	254	205	51,956	7.49
Cascade	424,994	34,802	1,771	125	461,692	1.46	266		38	304	187	56,843	8.12
Chouteau		4,988	30		5,018	3.70	11		3	14	131	1,838	2.73
Custer		12,802	25		12,827	1.49	12		3	15	167	2,504	5.12
Hill		7,933	55		7,988	3.47	12		4	16	183	2,928	2.73
Musselshell	739,364	42,298	3,227	2,466	787,355	1.91	406		186	592	179	106,213	7.41
Rosebud	1,124,052	2,978	885		1,127,915	.87	5	46	16	67	244	16,329	[9] 69.07
Other counties [13]		27,027	205	6	27,238	3.24	53	2	10	65	197	12,801	2.13
Total bituminous coal	2,638,636	168,279	8,948	3,073	2,818,936	1.45	935	48	344	1,327	189	251,412	11.21
Montana lignite [14]	5,472	41,666	1,030	96	48,264	[15] 1.78	60	8	16	84	161	13,499	3.58
Total Montana	2,644,108	209,945	9,978	[4] 3,169	2,867,200	1.45	995	56	360	1,411	188	264,911	10.82
NEW MEXICO													
Colfax	502,121	29,972	2,988	2,615	537,696	$2.89	644		135	779	140	108,884	4.94
McKinley	324,528	53,611	4,108	26,225	408,472	3.06	609		198	807	160	129,154	3.16
Rio Arriba	24,833	2,558			27,391	2.10	34		7	41	250	10,235	2.68
Other counties (Bernalillo, San Juan, Santa Fe, and Socorro)	97,384	28,266	3,856	7,550	137,056	3.21	275		56	331	242	80,143	1.71
Total New Mexico	948,866	114,407	10,952	[4] 36,390	1,110,615	2.97	1,562		396	1,958	168	328,416	3.38
NORTH DAKOTA (LIGNITE)													
Total North Dakota [14]	1,566,976	508,119	116,946	[4] 26,393	2,218,434	[16] $1.17	654	371	352	1,377	182	251,216	8.83

See footnotes at end of table.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Disposition of coal produced (net tons): Shipped by truck or wagon (excluding coal used by mine employees)	Disposition of coal produced (net tons): Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Disposition of coal produced (net tons): Used at mine for power and heat or made into beehive coke at mine	Disposition of coal produced (net tons): Total quantity	Average value per ton [3]	Average number of employees: Underground	Average number of employees: Surface: In strip pits	Average number of employees: Surface: All others	Average number of employees: Total	Average number of days mines were active	Number of man-days worked	Average tons per man per day
OHIO													
Athens	1,871,785	69,016	3,131	17,272	1,961,204	$1.89	2,123		347	2,470	191	472,700	4.15
Belmont	5,292,864	183,320	27,277	10,024	5,513,485	1.68	5,359	47	750	6,156	182	1,121,546	4.92
Carroll	96,560	332,395	3,275	389	432,619	1.88	335	49	55	439	204	89,485	4.83
Columbiana	25,180	681,507	488	1,575	708,750	1.56	243	116	56	415	219	91,019	[7] 7.79
Coshocton	14,738	242,416	5,619	1,060	263,833	1.87	268	14	45	327	220	71,830	3.67
Gallia	373	41,991	25		42,389	1.79	41	22	6	69	234	16,155	2.62
Guernsey	469,766	93,623	4,805	162	568,356	1.61	485		52	537	225	120,737	4.71
Harrison	2,913,309	38,181	748	12,564	2,964,802	1.53	1,005	126	302	1,433	251	359,101	[7] 8.26
Hocking	160,498	136,896	1,069	1	298,464	1.76	320	7	53	380	181	68,776	4.34
Holmes		40,274	138	49	40,461	2.21	43	7	10	60	223	13,396	3.02
Jackson	73,662	86,533	29,042	5	189,242	2.25	227	38	46	311	188	58,572	3.23
Jefferson	5,073,151	283,144	10,128	18,026	5,384,449	1.66	3,241	282	671	4,194	195	818,671	[7] 6.58
Lawrence		63,902	10,676		74,578	1.95	98	1	14	113	245	27,706	2.69
Mahoning		344,975	824	2,618	348,417	2.00	51	111	30	192	252	48,466	[8] 7.19
Meigs	60,998	98,550	304	15	159,867	1.61	232		38	270	170	46,009	3.47
Morgan	67,565	6,686	50		74,301	2.00	117		19	136	144	19,577	3.80
Muskingum	810,879	237,593	1,377	260	1,050,109	1.87	548	23	99	670	212	141,789	[7] 7.41
Perry	540,377	248,032	3,069	575	792,053	1.83	1,279	40	196	1,515	116	175,609	4.51
Stark		812,144	741	110	812,995	1.67	181	143	105	429	233	99,922	[7] 8.14
Tuscarawas	43,521	843,209	924	208	887,862	1.91	585	139	114	838	202	169,440	5.24
Vinton	250	77,513	315	908	78,986	2.01	37	39	22	98	206	20,206	3.91
Wayne		17,821		187	18,008	2.99	25	6	7	38	181	6,860	2.63
Other counties (Noble, Portage, Summit, and Washington)		105,492	185	645	106,322	1.97	50	17	17	84	226	19,006	5.59
Total Ohio	17,515,476	5,085,213	104,210	[4] 66,653	22,771,552	1.71	16,893	1,227	3,054	21,174	193	4,076,578	5.59

OKLAHOMA													
Coal		24,378	68	5	24,451	$3.22	43	5	10	58	164	9,527	2.57
Craig		10,303	26		10,329	2.43		10	4	14	172	2,404	4.30
Latimer	22,581	4,607	141	80	27,409	2.24	48		16	64	192	12,263	2.24
LeFlore	344,605	8,712	653	574	354,544	2.86	685		126	811	139	113,065	3.14
Okmulgee	316,789	33,584	278	1,208	351,859	2.36	259		49	308	224	69,072	5.09
Pittsburg	163,768	24,562	922	7,242	196,494	2.91	302		74	376	205	77,199	2.55
Rogers	41,350	49,025	224	6,128	96,727	2.12	2	41	15	58	223	12,933	[6] 7.48
Tulsa	19,645	24,857	35	280	44,817	2.51	93	5	19	117	157	18,323	2.45
Other counties:													
Haskell and Sequoyah	83,284	2,009	183	335	85,811	2.30	39	43	26	108	189	20,361	4.21
Muskogee and Wagoner	425,938	27,002	200	400	453,540	2.04		79	55	134	183	24,528	[6] 18.49
Total Oklahoma	1,417,960	209,039	2,730	[4] 16,252	1,645,981	2.44	1,471	183	394	2,048	176	359,675	4.58
PENNSYLVANIA (BITUMINOUS COAL)													
Allegheny	12,460,506	2,152,569	1,052,753	10,647	15,676,475	$1.93	11,002	229	1,608	12,839	226	2,907,702	5.39
Armstrong	3,981,667	123,251	45,953	705	4,151,576	1.92	3,549	77	396	4,022	223	895,687	4.64
Beaver	229,751	471,546	326	5,332	706,955	2.04	169	200	102	471	194	91,373	[7] 7.74
Bedford	70,341	108,270	218,964	[16] 1,598	399,173	2.69	586		86	672	175	117,902	3.39
Blair	87,477	90,408	2,002	292	180,179	2.30	368		48	416	167	69,580	2.59
Bradford		7,161	15		7,176	3.11	16		3	19	165	3,139	2.29
Butler	391,007	435,184	6,835	77	833,103	1.84	1,096	86	184	1,366	173	236,876	3.52
Cambria	13,974,735	490,315	1,739,636	[16] 181,558	16,386,244	2.23	18,018	11	2,397	20,426	202	4,117,613	3.98
Center	438,265	220,284	10,000	250	668,799	2.02	974	58	137	1,169	186	217,957	3.07
Clarion	1,409,694	290,961	26,814	238	1,727,707	1.72	1,545	153	207	1,905	194	369,247	4.68
Clearfield	3,096,809	306,612	5,350	27,265	3,436,036	2.04	4,547	155	624	5,326	184	978,157	3.51
Clinton		48,693	1,730	44	50,467	1.96	60		14	74	218	16,151	3.12
Elk	731,378	80,278	3,640	17,377	832,673	1.90	1,029	11	166	1,206	217	261,206	3.19
Fayette	19,258,729	586,308	123,903	[16] 2,222,107	22,191,047	2.10	17,290	248	1,971	19,509	230	4,482,274	4.95
Greene	5,152,483	11,589	17,241	[16] 20,846	5,202,159	2.16	3,564		657	4,221	218	918,723	5.66
Huntingdon	415,186	81,703	3,207	2,935	503,031	2.44	837		87	924	199	183,586	2.74
Indiana	6,314,991	93,348	284,823	[16] 313,330	7,006,492	1.84	5,906		803	6,709	201	1,345,692	5.21
Jefferson	1,970,248	132,036	4,337	1,585	2,108,206	1.91	2,157	57	240	2,454	196	480,368	4.39
Lawrence	218,717	61,130	2,290		282,137	2.70	443	10	46	499	195	97,277	2.90
Lycoming	7,492	63,752	812		72,056	2.36	107	6	22	135	217	29,332	2.46
Mercer	79,494	244,889	1,395	1,173	326,951	2.12	184	31	50	265	203	53,880	[6] 6.07
Somerset	4,705,960	170,665	31,284	52,414	4,960,323	2.15	5,942	34	822	6,798	182	1,239,082	4.00
Tioga	177,939	85,107	513	6,956	270,515	2.70	307	38	65	410	166	67,911	3.98
Venango	729	47,709	110	6	48,554	1.97	58	3	9	70	208	14,580	3.33
Washington	18,694,881	437,733	240,132	22,408	19,395,154	1.99	15,567	165	1,872	17,604	230	4,042,024	4.80
Westmoreland	7,295,472	737,987	151,471	[16] 800,417	8,985,347	1.89	7,431	99	1,087	8,617	211	1,815,869	4.95
Other counties (Cameron, Crawford, Forest, Fulton, and McKean)	163,034	31,078		352	194,464	2.42	244	14	36	294	212	62,192	3.13
Total Pennsylvania	101,326,985	7,610,566	3,975,536	[16] 3,689,912	116,602,999	2.04	102,996	1,685	13,739	118,420	212	25,115,380	4.64
SOUTH DAKOTA (LIGNITE)													
Total South Dakota [14]	37,285	28,521	264	15	66,085	[16] $1.33	12	39	12	63	168	10,577	6.25

See footnotes at end of table.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity	Average value per ton [3]	Average number of employees: Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines were active	Number of man-days worked	Average tons per man per day
TENNESSEE													
Anderson	1,049,275	58,346	8,418	1,573	1,117,612	$2.03	1,250		168	1,418	202	286,290	3.90
Bledsoe	43,000	9,569	430		52,999	1.50	80		11	91	198	18,030	2.94
Campbell	1,673,692	19,662	27,749	1,741	1,722,844	2.15	2,031		300	2,331	218	507,213	3.40
Claiborne	1,297,951	41,782	14,638	3,441	1,357,812	1.88	1,698		202	1,900	204	388, 58	3.50
Fentress	264,909	11,925	2,149	12,258	291,241	1.59	395		51	446	223	99,352	2.93
Hamilton		25,305	55		25,380	1.80	39		3	42	170	7,130	3.56
Marion	447,802	43,942	4,120	1,750	497,614	2.24	667		106	773	208	160,742	3.10
Morgan	191,739	18,527	2,096	9,228	221,590	1.71	329		103	432	230	99,489	2.23
Overton	1,969	18,117	20	20	20,126	1.61	33		8	41	188	7,710	2.61
Scott	96,761	10,979	912	2,860	111,512	1.76	139	3	38	180	187	33,629	3.32
Sequatchie	18,426	50,722	142	281	69,571	2.24	98		24	122	150	18,351	3.79
Van Buren		16,007	239	90	16,336	2.02	33		12	48	175	8,384	1.95
White		5,920	54	105	6,079	1.89	19		4	23	179	4,120	1.48
Other counties:													
Cumberland and Putnam	60,379	17,381	791		78,551	1.64	94		50	144	192	27,595	2.85
Grundy and Rhea	366,843	36,639	6,133	[17] 9,594	419,209	2.02	505		70	575	196	112,864	3.71
Total Tennessee	5,512,746	384,823	67,946	[17] 42,941	6,008,456	2.00	7,413	3	1,150	8,566	208	1,779,057	3.38
TEXAS													
Texas bituminous coal:													
Palo Pinto, Webb, and Wise	8,530	5,565	42		14,137	$3.42	67		14	81	99	8,003	1.77
Total bituminous coal	8,530	5,565	42		14,137	3.42	67		14	81	99	8,003	1.77
Texas lignite [14]	592,720	6,784	3,650	3,264	606,418	[15] 1.05	476	16	54	546	170	92,615	6.55
Total Texas	601,250	12,349	3,692	[4] 3,264	620,555	1.10	543	16	68	627	160	100,618	6.17

UTAH														
Carbon	2,478,685	264,446	15,280	[11] 21,801	2,779,712	$2.21	1,523	-------	552	2,075	176	365,533	7.60
Emery	570,247	111,889	4,846	4,613	691,595	2.18	267	-------	121	388	201	78,037	8.86
Sevier	-------	4,528	28	-------	4,556	2.30	10	-------	3	13	117	1,522	2.99
Summit	27,839	21,998	648	35	50,520	1.92	42	-------	20	62	247	15,304	3.30
Other counties (Grand, Iron, and Uintah)	35,658	13,360	161	24	49,203	2.49	40	-------	12	52	216	11,210	4.39
Total Utah	3,112,429	416,221	20,963	[11] 25,973	3,575,586	2.20	1,882	-------	708	2,590	182	471,606	[7] 7.58
VIRGINIA													
Buchanan	4,859,945	4,321	9,925	120	4,874,311	$1.84	3,664	-------	440	4,104	205	839,496	5.81
Dickenson	1,746,031	13,937	6,815	799	1,767,582	1.82	1,540	-------	233	1,773	246	436,780	4.05
Lee	1,327,866	79,247	12,672	[19] 898	1,420,683	2.15	1,581	-------	298	1,879	215	403,084	3.52
Montgomery	163,223	8,734	-------	1,500	173,457	2.08	220	-------	45	265	183	48,620	3.57
Russell	540,093	56,689	6,320	3,168	606,270	2.00	696	-------	158	854	154	131,370	4.61
Tazewell	3,187,287	54,891	30,734	10,223	3,283,135	2.08	3,313	-------	525	3,838	203	779,150	4.21
Wise	2,754,286	80,019	23,921	[19] 335,214	3,193,440	1.95	3,722	-------	501	4,223	174	733,163	4.36
Other counties (Chesterfield and Scott)	4,003	24,125	919	150	29,197	2.38	57	5	22	84	233	19,560	1.49
Total Virginia	14,582,734	321,963	91,306	[19] 352,072	15,348,075	1.95	14,793	5	2,222	17,020	199	3,391,223	4.53
WASHINGTON													
King	320,875	265,265	5,379	489	592,008	$3.41	667	5	190	862	214	184,493	3.21
Kittitas	690,779	23,482	36,839	9,885	760,985	2.94	738	-------	207	945	186	176,060	4.32
Lewis	9,765	27,988	95	371	38,219	2.57	39	-------	7	46	202	9,274	4.12
Pierce	23,107	15,028	381	70	38,586	3.49	57	-------	9	66	189	12,493	3.09
Other counties (Thurston and Whatcom)	174,566	41,844	1.307	2,837	220,554	3.32	337	-------	69	406	134	54,210	4.07
Total Washington	1,219,092	373,607	44,001	[4] 13,652	1,650,352	3.16	1,838	5	482	2,325	188	436,530	3.78

See footnotes at end of table.

TABLE 46.—*Production, value, employment, days active, man-days, and output per man per day at bituminous coal and lignite mines in the United States in 1940, by States and counties*—Continued

County	Disposition of coal produced (net tons): Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity	Average value per ton [3]	Average number of employees: Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines were active	Number of man-days worked	Average tons per man per day
WEST VIRGINIA													
Barbour	1,503,468	4,460	1,825	92	1,509,845	$1.70	1,361		167	1,528	186	284,933	5.30
Boone	3,824,535	5,570	17,675	2,013	3,849,793	1.83	3,010		556	3,566	196	698,179	5.51
Braxton	3,552	1,263	10,880		15,695	1.66	22		5	27	129	3,476	4.52
Brooke	519,806	472,220	951,095	73	1,943,194	1.63	770	72	164	1,006	228	229,735	[7] 8.46
Clay	738,178		20,364	26,931	785,473	1.80	429		120	549	280	153,811	5.11
Fayette	11,840,162	20,169	292,087	[10] 334,895	12,487,313	2.04	10,814		1,529	12,343	211	2,601,450	4.80
Gilmer	13,435	3,485	16		16,936	1.57	27		6	33	123	4,075	4.16
Grant		47,291	398	328	48,017	2.24	110		20	130	214	27,836	1.72
Greenbrier	1,559,311	69,249	10,159	306	1,639,025	1.95	1,655		225	1,880	181	341,171	4.80
Hancock	8,552	171,997			180,549	1.22	38	18	21	77	196	15,111	[7] 11.95
Harrison	3,826,676	37,316	71,326	4,228	3,939,546	1.64	2,071	7	516	2,594	194	504,395	[7] 7.81
Kanawha	7,133,162	58,072	65,192	5,994	7,262,420	1.84	6,030		768	6,798	211	1,434,719	5.06
Lewis		13,004	40		13,044	1.14	12		2	14	240	3,355	3.89
Logan	17,062,227	17,776	115,695	3,157	17,198,855	1.68	9,262		2,183	11,445	211	2,420,329	[7] 7.11
McDowell	24,503,550	33,276	274,980	83,119	24,894,925	1.92	17,171		3,370	20,541	219	4,498,992	5.53
Marion	8,732,274	52,850	219,012	44,035	9,048,171	1.65	5,080		829	5,909	216	1,277,108	[7] 7.08
Marshall	317,597	106,376	160,474	2,859	587,306	1.98	470		67	537	229	122,760	4.78
Mason	34,991	49,331	305	265	84,892	1.51	133		34	167	171	28,589	2.97
Mercer	3,749,698	16,593	29,024	1,213	3,796,528	1.96	3,181		622	3,803	227	861,388	4.41
Mineral	125,243	43,653	320	56	169,272	2.33	432		59	491	159	77,933	2.17
Mingo	3,414,228	4,802	24,428		3,443,458	1.71	2,694		463	3,157	199	626,953	5.49
Monongalia	7,974,667	69,047	27,549	156	8,071,419	1.46	3,437		873	4,310	225	971,458	[7] 8.31
Nicholas	22,564	62,466	3,288		88,318	1.74	156		21	177	144	25,451	3.47
Ohio	1,560,992	194,086	8		1,755,086	1.64	1,266		154	1,420	269	381,836	4.60
Preston	647,238	17,533	122,287	[10] 48,154	835,212	1.66	814	30	163	1,007	197	198,864	4.20
Putnam	557,026	2,160	4,077	222	563,485	1.82	636		57	693	222	154,111	3.66
Raleigh	15,284,168	47,623	136,396	61,518	15,529,705	1.99	11,645		1,904	13,549	233	3,151,433	4.93
Randolph	1,038,313	58,986	5,925	19,447	1,122,671	1.94	1,067		222	1,289	198	254,795	4.41
Taylor	311,924	19,261	548	5	331,738	1.75	348		62	410	153	62,792	5.28
Tucker	508,392	5,021	3,652	20,404	537,469	2.20	478		64	542	210	113,581	4.73
Upshur	112,343	18,131	139	831	131,444	1.63	124		41	165	138	22,820	5.76

Webster	1,028,344	21	774	3,135	1,032,274	2.20	936	....	153	1,069	199	217,062	4.76
Wyoming	3,441,204	7,412	28,176	20,829	3,497,621	2.14	2,967	....	474	3,441	227	782,170	4.47
Other counties (Lincoln, Summers, and Wayne)	13,348	13,518	56	....	26,922	1.13	38	....	10	48	154	7,398	3.64
Total West Virginia	121,411,168	1,744,018	2,598,170	[20] 684,265	126,437,621	1.83	88,684	127	15,924	104,735	215	22,560,069	5.60
WYOMING													
Carbon	581,664	29,528	2,852	16,416	630,460	$2.02	242	16	92	350	192	67,265	9.37
Converse	....	18,355	20	....	18,375	1.76	4	8	2	14	245	3,425	5.36
Fremont	21,250	11,299	415	4,769	37,733	2.40	25	....	10	35	140	4,906	7.69
Hot Springs	47,653	22,402	327	6	70,388	3.19	118	....	20	138	130	17,944	3.92
Johnson	....	11,432	85	253	11,770	1.80	8	....	4	12	245	2,936	4.01
Lincoln	411,937	28,206	4,379	7,706	452,228	2.50	375	....	111	486	184	89,643	5.04
Sheridan	561,233	32,410	8,502	670	602,815	1.68	320	3	93	416	161	66,875	9.01
Sweetwater	3,758,276	10,389	21,795	59,231	3,849,691	2.07	2,237	....	483	2,720	171	466,224	8.26
Other counties (Campbell, Park, and Uinta)	99,924	23,756	675	10,227	134,582	1.30	17	22	15	54	256	13,818	9.74
Total Wyoming	5,481,937	187,777	39,050	[4] 99,278	5,808,042	2.06	3,346	49	830	4,225	173	733,036	[7] 7.92

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mines to points of use by conveyor, chute, or aerial tramway.

[3] Value received or charged for coal, f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[4] No coal was made into beehive coke at mines in 1940.

[5] Includes 95,735 tons made into beehive coke at mines in Las Animas County, Colo., in 1940.

[6] "Other counties" in Illinois include Adams, Bond, Crawford, Hancock, Jefferson, Logan, McDonough, Macon, Marion, Marshall, Montgomery, Scott, Warren, White, Will, and Woodford.

[7] Much of output is obtained from strip pits or by use of loading machines, in which types of operations production per man per day is large.

[8] Production of Home Riverside and Alston mines is credited to Missouri; production of Hume-Sinclair (Tiger mine) is credited to Kansas.

[9] Output obtained chiefly from strip pits in which production per man per day is large.

[10] Includes 1,273 tons made into beehive coke at mines in Jackson County, Ky., in 1940.

[11] "Other counties" in Eastern Kentucky include Elliott, Greenup, Lawrence, Leslie, Magoffin, Martin, Morgan, and Owsley.

[12] "Other counties" in Missouri include Audrain, Chariton, Clark, Dade, Daviess, Grundy, Howard, Jasper, Johnson, Lincoln, Miller, Monroe, Morgan, and Saline.

[13] "Other counties" in Montana bituminous coal include Blaine, Fergus, Flathead, Judith Basin, Park, Phillips, Pondera, and Powder River.

[14] Figures on lignite compiled by Bureau of Mines, see lignite tables, 1940, at end of this chapter. As lignite schedule did not require exactly same break-down on disposition of coal produced as shown in this table, an estimate has been made where feasible for items "shipped by truck or wagon," "used by mine employees," "taken by locomotive tenders at tipple," and "transported from mines to points of use by conveyor, chute, or aerial tramway." Sum of these items equals sum of items "commercial sales by truck or wagon" and "other sales to local trade, or used by employees, or taken by locomotives at tipple," as published by Bureau of Mines. For more detailed information on lignite by counties, see section on lignite at end of chapter.

[15] Excludes selling cost.

[16] Includes coal made into beehive coke at mines in following counties in Pennsylvania in 1940. Bedford, 989 tons, Cambria, 45,882 tons; Fayette, 2,199,593 tons; Greene, 3,098 tons; Indiana, 233,673 tons; and Westmoreland, 756,229 tons—State total, 3,239,464 tons.

[17] Includes 8,818 tons made into beehive coke at mines in Grundy County, Tenn., in 1940.

[18] Includes 14,537 tons made into beehive coke at mines in Carbon County, Utah, in 1940.

[19] Includes coal made into beehive coke at mines in following counties in Virginia in 1940. Lee, 800 tons: Wise, 330,018 tons; State total, 330,818 tons.

[20] Includes coal made into beehive coke at mines in following counties in West Virginia in 1940: Fayette, 306,487 tons; Preston, 47,918 tons; State total, 354,405 tons.

STATISTICS ON LIGNITE IN 1940[3]

PRODUCTION

The Bureau of Mines prepares final statistics of the lignite industry from an annual canvass, by mail, of operators of lignite properties included in the areas mapped as "lignite" in Geological Survey Professional Paper 100–A, The Coal Fields of the United States. Subbituminous coal is not included. The data on individual operations furnished by the producers are voluntary and confidential, as is customary in the statistical surveys of the Bureau of Mines.

Lignite production in 1940 totaled 2,939,201 net tons, a small decrease from the 3,042,537 tons produced in 1939. These figures are exclusive of many of the small mines producing less than 1,000 tons. The average value per ton was $1.16 in 1940 compared with $1.13 in 1939. The average value per ton by States ranged from a low of $1.05 for Texas to a high of $1.78 for Montana. The number of men employed in 1940 totaled 2,070 compared with 2,096 in 1939, and the average output per man per day for the same periods was 7.99 and 7.61 tons, respectively. The average number of days worked by the industry was 178 in 1940 compared with 191 in 1939. A much larger percentage of the total output of lignite results from stripping operations than in either anthracite or bituminous-coal mining. Of the total lignite output 48 percent (1,447,449 tons) was produced in strip pits in 1939 whereas 51 percent (1,512,308 tons) of the total in 1940 resulted from strip-pit operations. No labor disturbances were reported.

In 1940, as for many years in the past, North Dakota was the largest producer of lignite, followed in order by Texas, South Dakota, and Montana. The North Dakota output represented 75 percent of the United States total, that of Texas 21 percent, and South Dakota and Montana together 4 percent.

Reports of the Federal Power Commission show that 1,538,174 tons of lignite were consumed in 1939 for generating electric energy in the United States. In 1940, 1,452,412 tons were so used, and this tonnage was equivalent to 49 percent of the total production. Consumption in the West North Central Division was 547,366 tons, in the West South Central and Mountain Divisions 516,531 and 386,991 tons, respectively, and in the East South Central Division, 1,524 tons.

The following tables include detailed statistics on the lignite industry in 1940. Similar data for 1941 were not available in time to be included in this chapter, but they will be published later in mimeographed form and may be obtained upon request to the Coal Economics Division of the Bureau of Mines.

[3] Compiled by J. A. Corgan and A. V. Coleman, Coal Economics Division, Bureau of Mines.

TABLE 47.—*Summary of production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1940, by States*

	North Dakota	Texas	South Dakota	Montana [1]	Total
Production (net tons):					
Loaded at mines for shipment	1,566,976	592,720	37,285	5,472	2,202,453
Commercial sales by truck or wagon	447,694	6,784	28,521	41,666	524,665
Other sales to local trade, or used by employees, or taken by locomotives at tipple	[2] 177,371	3,650	[2] 279	1,030	[2] 182,330
Used at mines for power and heat	26,393	3,264	([3])	96	[3] 29,753
Total production: 1940	2,218,434	606,418	66,085	48,264	2,939,201
1939	2,131,252	814,022	49,495	47,768	3,042,537
Value:					
Total: 1940	$2,587,000	$637,000	$88,000	$86,000	$3,398,000
1939	$2,425,000	$875,000	$69,000	$83,000	$3,452,000
Average per net ton: 1940	$1.17	$1.05	$1.33	$1.78	$1.16
1939	$1.14	$1.07	$1.39	$1.74	$1.13
Number of employees:					
Underground	654	476	12	60	1,202
Surface (including strip pits)	723	70	51	24	868
Total employees: 1940	1,377	546	63	84	2,070
1939	1,391	559	53	93	2,096
Average number of days mines operated:					
1940	182	170	168	161	178
1939	179	231	160	146	191
Man-days of labor: 1940 [4]	251,216	92,615	10,577	13,499	367,907
1939	248,755	129,120	8,502	13,565	399,942
Average output per man per day (net tons):					
1940	8.83	6.55	6.25	3.58	7.99
1939	8.57	6.30	5.82	3.52	7.61

[1] Includes output of Custer, Dawson, McCone, Richland, Roosevelt, Sheridan, and Valley Counties.
[2] Includes some lignite "made into briquets."
[3] Small amount of colliery fuel included in "Other sales to local trade."
[4] Based upon (1) "reported" number of man-shifts where operator keeps a record thereof; otherwise upon (2) "calculated" number of man-shifts, obtained by multiplying average number of men employed underground and on surface at each mine by number of days worked by mine and tipple, respectively. Using throughout "calculated" man-shifts as developed before the year 1932—namely, product of total number of men employed at each mine times tipple days—the average output per man per day was 8.59 in 1940.

TABLE 48.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1940, by States and counties*

MONTANA

County	Total production (net tons)	Value		Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average net tons per man per day [1]
		Total (thousand dollars)	Average per net ton				
Custer, Dawson, and Valley	8,579	14	$1.63	14	1,886	135	4.55
McCone	4,358	8	1.84	10	1,484	148	2.94
Richland and Roosevelt	19,362	39	2.01	36	5,689	158	3.40
Sheridan	15,965	25	1.57	24	4,440	185	3.60
Total Montana: 1940	48,264	86	1.78	84	13,499	161	3.58
1939	47,768	83	1.74	93	13,565	146	3.52

See footnotes at end of table.

TABLE 48.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1940, by States and counties*—Continued

NORTH DAKOTA

County	Total production (net tons)	Value: Total (thousand dollars)	Value: Average per net ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average net tons per man per day [1]
Adams	48,434	61	$1.26	80	11,977	150	4.04
Billings, Bowman, Dunn, and Slope	12,163	19	1.56	19	3,020	159	4.03
Burke	260,480	305	1.17	84	17,468	208	[2] 14.91
Burleigh	255,885	307	1.20	85	18,726	220	[2] 13.66
Divide	154,070	204	1.32	62	9,877	159	[2] 15.60
Golden Valley	6,825	8	1.17	15	2,286	152	2.99
Grant	24,791	31	1.25	35	5,070	145	4.89
Hettinger	14,800	19	1.28	24	3,828	160	3.87
McKenzie	5,690	8	1.41	12	1,550	129	3.67
McLean	142,123	178	1.25	173	24,278	140	5.85
Mercer	621,905	661	1.06	270	54,813	203	11.35
Morton	24,107	30	1.24	44	5,744	131	4.20
Mountrail	6,041	8	1.32	18	2,823	157	2.14
Oliver	13,023	13	1.00	23	3,585	156	3.63
Stark	113,457	127	1.12	75	18,960	253	5.98
Ward	477,016	558	1.17	300	58,334	194	[2] 8.18
Williams	37,624	50	1.33	58	8,877	153	4.24
Total North Dakota: 1940	2,218,434	2,587	1.17	1,377	251,216	182	8.83
1939	2,131,252	2,425	1.14	1,391	248,755	179	8.57

SOUTH DAKOTA

County	Total production (net tons)	Value: Total (thousand dollars)	Value: Average per net ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average net tons per man per day [1]
Corson and Dewey	61,077	80	$1.31	44	8,813	200	6.93
Harding and Meade	1,809	4	2.21	10	770	77	2.35
Perkins	3,199	4	1.25	9	994	110	3.22
Total South Dakota: 1940	66,085	88	1.33	63	10,577	168	6.25
1939	49,495	69	1.39	53	8,502	160	5.82

TEXAS

County	Total production (net tons)	Value: Total (thousand dollars)	Value: Average per net ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average net tons per man per day [1]
Bastrop and Milam	73,947	48	$0.65	113	11,195	99	6.61
Henderson, Titus, and Wood	532,471	589	1.11	433	81,420	188	6.54
Total Texas: 1940	606,418	637	1.05	546	92,615	170	6.55
1939	814,022	875	1.07	559	129,120	231	6.30

[1] Based upon (1) "reported" number of man-shifts where operator keeps a record thereof, otherwise upon (2) "calculated" number of man-shifts obtained by multiplying average number of men employed underground and on surface at each mine by number of days worked by mine and tipple, respectively. Using throughout "calculated" man-shifts as developed before the year 1932—namely, product of total number of men employed at each mine times tipple days—the average output per man per day in 1940 was 3.58 in Montana, 9.88 in North Dakota, 5.48 in South Dakota, and 6.56 in Texas.

[2] Output obtained chiefly from strip pits, in which production per man per day is large.

NUMBER AND SIZE OF MINES

Reports were received from 208 lignite mines in 1940. This is exclusive of many small mines producing less than 1,000 tons a year and is comparable with 206 mines reporting in 1939. North Dakota, producing about 75 percent of the total lignite output, reported 164 mines; Montana was next in order with 22 mines; South Dakota and Texas followed with 14 and 8, respectively. Five mines produced from 200,000 to more than 500,000 tons each, and the output of these mines amounted to 57 percent of the total production; 2 reported production of 100,000 to 200,000 tons each and accounted for 11 percent of the total; 3 mines reported an output of 50,000 to 100,000

tons each and accounted for 8 percent of the total; 15 mines in the 10,000- to 50,000-ton class reported 10 percent of the total; and 183 mines producing less than 10,000 tons each accounted for 14 percent of the total.

METHODS OF RECOVERY

TABLE 49.—*Lignite mined by different methods in the United States in 1940, by States, in net tons*

State	Mined by hand	Shot off the solid	Cut by machines [1]	From strip pits	Not specified	Total
Montana	[2] 53,622	[2] 538,396	12,964	[2] 44,916	4,784	48,264
North Dakota	111,044	119,274	557,408	1,405,590	25,118	2,218,434
South Dakota	2,465			61,802	1,818	66,085
Texas	(2)	(2)		(2)		606,418
Total	167,131	657,670	570,372	1,512,308	31,720	2,939,201

[1] A total of 20 machines was used—13 "permissible" and 7 of other types.
[2] Texas included with Montana.

STRIPPING OPERATIONS

Lignite recovered by stripping operations in 1940 totaled 1,512,308 tons—51 percent of the output of the industry. In 1940 the total production of lignite in North Dakota was 2,218,434 net tons; of this amount, 1,405,590 tons (63 percent) came from strip-pit operations. The output from strip pits in Texas, Montana, and South Dakota was only 106,718 tons. The number of men employed in stripping operations was 588, with an average output per man per day of 12.87 tons; 200 days was the average worked.

Table 50 gives detailed statistics for stripping operations in the lignite industry in 1940.

TABLE 50.—*Summary of stripping operations that produced lignite in the United States in 1940, by States*

State	Number of strip pits [1]	Number of shovels, dragline excavators, and coal-loading machines [2]	Coal mined by stripping (net tons)	Total value at mines (thousand dollars)	Average value per net ton	Number of employees: In strip pits	Number of employees: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor [3]	Average net tons per man per day [3]
Montana and Texas	5	2	44,916	26	$0.58	24	1	25	104	2,599	17.28
North Dakota	52	35	1,405,590	1,605	1.14	371	144	515	206	105,868	13.28
South Dakota	8	2	61,802	81	1.31	39	9	48	188	9,023	6.85
Total	65	39	1,512,308	1,712	1.13	434	154	588	200	117,490	12.87

[1] Includes some pits in which stripping is done by hand.
[2] In some cases, same equipment was used for stripping or excavating and for loading coal, such duplication has been eliminated. In some cases, coal was excavated by machine and loaded by hand.
[3] Based upon (1) "reported" number of man-shifts where operator keeps an accurate record thereof, otherwise upon (2) "calculated" number of man-shifts, obtained by multiplying number of men employed at tipple, in loading coal, etc., and in stripping overburden by number of days worked in each department in so far as separately reported by operator.

WORLD PRODUCTION

TABLE 51.—*World production of lignite (including brown coal), 1936–41, in metric tons* [1]

[Compiled by B. B. Waldbauer]

Country [1]	1936	1937	1938	1939	1940	1941
North America:						
Canada	3,507,895	3,352,316	3,153,377	3,093,514	3,294,621	3,666,604
United States	2,821,048	2,919,685	2,719,654	2,760,129	2,666,384	(2)
Europe:						
Albania	3,130	3,500	3,866	(2)	(2)	(2)
Bulgaria	1,576,098	1,732,119	1,855,198	2,134,051	2,700,000	(2)
Czechoslovakia	15,948,767	17,895,411	14,716,693	(2)	(2)	(2)
Faroe Islands	----------	----------	8,000	8,000	(2)	(2)
France	943,230	1,015,000	1,057,250	(2)	(2)	(2)
Germany	160,276,036	183,538,054	195,312,067	230,000,000	(2)	(2)
Austria	2,897,203	3,241,770	3,341,730	(2)	(2)	(2)
Greece	105,621	131,083	108,010	139,095	(2)	(2)
Hungary	7,105,004	8,055,123	8,317,600	9,518,400	9,484,600	(2)
Italy	768,563	1,059,231	872,950	1,058,000	(2)	(2)
Netherlands	88,779	143,057	170,637	196,810	(2)	(2)
Poland	13,518	18,915	9,526	(2)	(2)	(2)
Portugal	20,677	23,098	14,854	35,113	66,658	92,731
Rumania	1,671,825	1,880,477	2,096,698	2,300,000	(2)	(2)
Spain	199,031	207,896	165,801	205,000	567,930	[3] 381,000
U. S. S. R.	(4)	(4)	(4)	(2)	15,900	(2)
Yugoslavia	4,034,577	4,574,232	5,286,781	5,621,972	(2)	(2)
Asia:						
Indochina	----------	----------	4,200	27,000	30,000	(2)
Japan	109,494	(4)	(4)	(2)	(2)	(2)
Syria and Lebanon	493	4,658	700	1,000	2,365	(2)
Turkey	95,234	116,397	129,315	151,267	(2)	(2)
Oceania:						
Australia: Victoria	3,093,768	3,448,391	3,734,441	3,709,613	(2)	(2)
New Zealand	1,301,895	1,328,805	1,264,208	1,318,863	1,393,555	(2)
	224,408,000	254,814,000	264,469,000	(2)	(2)	(2)

[1] Lignite is also mined in Italian East Africa, but complete production figures are not available.
[2] Data not available.
[3] January to June, inclusive.
[4] Estimate included in total.

IMPORTS AND EXPORTS

TABLE 52.—*Bituminous coal* [1] *imported for consumption in the United States, 1940–41, by countries and customs districts, in net tons*

	1940	1941 (Jan.–Sept.)
COUNTRY		
North America: Canada	360,975	276,619
Europe: United Kingdom	10,596	2,133
	371,571	278,752
CUSTOMS DISTRICT		
Alaska	6,339	3,410
Buffalo	22	--------
Chicago	2	1
Dakota	272	88
Duluth and Superior	333	1,412
Hawaii	1,496	--------
Maine and New Hampshire	191,429	153,392
Maryland	1,792	179
Montana and Idaho	127,274	96,332
New Orleans	140	--------
New York	896	--------
Philadelphia	1,344	1,953
St. Lawrence	634	376
Vermont	202	670
Washington	39,396	20,939
	371,571	278,752

[1] Includes slack, culm, and lignite.

TABLE 53.—*Bituminous coal exported from the United States, 1937–41*

Year	Net tons [1]	Value
1937	13,144,678	$48,821,270
1938	10,490,269	38,104,926
1939	11,590,478	42,778,473
1940	16,465,928	$60,832,066
1941 (Jan.–Sept.)	13,845,158	56,624,365

[1] Quantities stated do not include fuel or bunker coal loaded on vessels engaged in foreign trade, which aggregated 1,831,650 tons in 1937, 1,352,480 tons in 1938, 1,476,556 tons in 1939, 1,426,836 tons in 1940, and 1,119,812 tons in 1941 (January-September).

WORLD PRODUCTION

TABLE 54.—*World production of coal and lignite, 1937–41, by countries, in thousands of metric tons* [1]

[Compiled by B. B. Waldbauer, Bureau of Mines]

Country [1]	1937	1938	1939	1940	1941
North America:					
Canada:					
Coal	11,014	9,815	10,985	12,628	12,871
Lignite	3,352	3,153	3,094	3,295	3,660
Greenland	6	7	(2)	6	(2)
Mexico	912	893	628	816	856
United States:					
Anthracite	47,043	41,820	46,708	46,706	51,136
Bituminous	401,257	313,473	355,445	415,336	463,832
Lignite	2,920	2,720	2,760	2,666	
South America:					
Brazil	763	883	1,047	1,336	1,408
Chile	1,988	2,044	1,850	1,937	2,051
Colombia	330	331	349	521	(2)
Peru	99	75	108	153	195
Venezuela	7	6	3	5	(2)
Europe:					
Albania: Lignite	4	4	(2)	(2)	(2)
Belgium	29,859	29,585	29,847	(2)	(2)
Bulgaria:					
Coal	120	142	164	188	(2)
Lignite	1,732	1,855	2,134	2,700	(2)
Czechoslovakia:					
Coal	16,778	15,800	(2)	(2)	(2)
Lignite	17,895	14,717	(2)	(2)	(2)
Eire	128	120	120	118	155
Faroe Islands: Lignite	------------	8	8	(2)	(2)
France:					
Coal	44,319	46,498	51,000	(2)	(2)
Lignite	1,015	1,057			
Germany:					
Coal	184,513	186,177	200,000	(2)	(2)
Lignite	183,538	195,312	230,000	(2)	(2)
Austria:					
Coal	230	227	(2)	(2)	(2)
Lignite	3,242	3,342	(2)	(2)	(2)
Greece. Lignite	131	108	139	(2)	(2)
Hungary:					
Coal	917	1,042	1,107	1,207	(2)
Lignite	8,055	8,317	9,518	9,485	(2)
Italy:					
Coal	964	1,480	2,025	(2)	(2)
Lignite	1,059	873	1,058	(2)	(2)
Netherlands:					
Coal	14,321	13,488	12,861	(2)	(2)
Lignite	143	171	197	(2)	(2)
Poland:					
Coal	36,218	38,104	(2)	(2)	(2)
Lignite	19	10	(2)	(2)	(2)
Portugal:					
Coal	259	299	313	310	460
Lignite	23	15	35	67	93
Rumania:					
Coal	303	299	285	(2)	(2)
Lignite	1,880	2,097	2,300	(2)	(2)
Spain:					
Coal	2,084	5,649	6,755	8,849	[3] 4,2[illegible]8
Lignite	208	166	205	568	[3] 3[illegible]1
Svalbard (Spitsbergen)	766	627	640	(2)	(2)
Sweden	460	431	444	(2)	(2)
Switzerland	4	3	3	8	(2)
United Kingdom:					
Great Britain	244,268	230,659	236,700	(2)	(2)
Northern Ireland	1	(4)	(2)	(2)	(2)
U. S. S. R.:					
Coal	94,525	98,627	(2)	148,700	(2)
Lignite				15,900	(2)
Yugoslavia:					
Coal	428	450	444	(2)	(2)
Lignite	4,574	5,287	5,622	(2)	(2)

See footnotes at end of table.

TABLE 54.—*World production of coal and lignite, 1937–41, by countries, in thousands of metric tons* [1]—Continued

Country [1]	1937	1938	1939	1940	1941
Asia:					
British Borneo	(4)	(4)	(4)	(2)	(2)
China	(5)	(5)	(2)	[6] 17,829	(2)
Chosen	2,348	3,200	4,481	(2)	(2)
Federated Malay States	638	486	448	794	(2)
India, British	26,074	28,798	28,214	(2)	(2)
Indochina:					
Coal	2,308	2,340	2,588	2,456	(2)
Lignite	----------	4	27	30	(2)
Japan:					
Japan proper:					
Coal	(5)	(5)	(2)	(2)	(2)
Lignite	(5)	(5)	(2)	(2)	(2)
Karafuto	(5)	(5)	(2)	(2)	(2)
Taiwan	(5)	(5)	(2)	(2)	(2)
Netherlands Indies	1,364	1,457	1,781	2,009	(2)
Philippine Islands	22	41	47	(2)	(2)
Syria and Lebanon: Lignite	5	(4)	1	2	(2)
Turkey:					
Coal	2,307	2,589	2,696	(2)	(2)
Lignite	116	129	151	(2)	(2)
U. S. S. R.: Coal, Lignite	32,616	34,261	(2)	(2)	(2)
Africa:					
Algeria	14	13	(2)	50	(2)
Belgian Congo: Coal	36	42	(2)	23	(2)
Morocco, French	107	123	116	143	(2)
Nigeria	369	368	311	313	(2)
Portuguese East Africa	19	10	8	20	(2)
Southern Rhodesia	1,029	1,044	1,118	(2)	(2)
Union of South Africa	15,491	16,284	16,890	17,176	[7] 13,568
Oceania:					
Australia:					
New South Wales	10,213	9,725	11,376	(2)	(2)
Queensland	1,138	1,131	1,339	(2)	(2)
Tasmania	93	85	99	(2)	(2)
Victoria:					
Coal	262	312	371	(2)	(2)
Lignite	3,448	3,734	3,710	(2)	(2)
Western Australia	562	614	566	548	(2)
New Zealand:					
Coal	986	994	1,061	1,163	(2)
Lignite	1,329	1,264	1,319	1,393	(2)
Total, all grades	1,550,000	1,469,000	(2)	(2)	(2)
Lignite (total of items shown above)	255,000	264,000	(2)	(2)	(2)
Bituminous and anthracite (by subtraction)	1,295,000	1,205,000	(2)	(2)	(2)

[1] Coal is also mined in Argentina, Iran, and Italian East Africa. Production figures for these countries are not available, but estimates are included in the totals.
[2] Data not yet available.
[3] January to June, inclusive.
[4] Production less than 1,000 tons.
[5] Estimate included in total.
[6] Exclusive of Kwantung Leased Territory and Manchuria.
[7] January to September, inclusive.

PENNSYLVANIA ANTHRACITE

By J. A. Corgan, Robert H. Ridgway, and A. V. Coleman

SUMMARY OUTLINE

REVIEW OF 1941

The production of Pennsylvania anthracite in 1941 was 56,368,267 net tons—a substantial increase from the 51,484,640 tons produced in 1940, due in part to increased consumer purchasing power, high industrial activity under pressure of war, substitution of anthracite for coke in some sections of the market, and inclusion in the 1941 figures of some illicit coal heretofore not considered in the Bureau's statistics. Compared with the First World War, the 1941 output was only a little more than half the 99,611,811 tons produced in 1917. The notable decrease in production during the period between the two wars has been due mostly to the inroads made by oil, coke, and bituminous coal in the principal anthracite markets and the loss of a large part of the market west of Buffalo, N. Y. The production figures include fresh-mined coal from underground and strip-pit operations, culm-bank output, and river coal recovered from the streams draining the Pennsylvania anthracite fields.

Much of the industry continued to operate under the voluntary production-control program inaugurated in January 1940 by the Commonwealth of Pennsylvania, the United Mine Workers of America, and producers representing more than 90 percent of the total anthracite production. By act of the General Assembly of the

Commonwealth of Pennsylvania, the State Secretary of Commerce took over administration of the program, effective November 10, 1941. It is believed that the program has benefited the anthracite industry and doubtless has brought production in closer alinement with current demand. Operation of the plan has helped also to partially solve the "bootleg" or illicit-coal problem, which has created undesirable social and industrial conditions in Pennsylvania for several years.

A joint resolution passed by the United States Senate and House of Representatives and approved by the President in December 1941 created a body known as the Federal Anthracite Coal Commission to investigate ways and means for improving economic conditions in the anthracite-producing regions of the United States. The Commission met several times in the Pennsylvania anthracite regions early in 1942, and representatives of the anthracite industry and others interested in the welfare of the anthracite regions presented a picture of the social and economic conditions resulting from the decline in anthracite production. Facts pertaining to these conditions were gathered and in April 1942 were submitted in a report to the President and the Congress.

Freight rates for anthracite were not changed greatly during 1941. Minor adjustments and equalizations were made. The so-called motor-compelled rates—inaugurated originally to compete with the trucking of anthracite—were to expire December 20, 1941, but were extended for 6 months.

Early in 1942 the Interstate Commerce Commission authorized the rail and water carriers to increase the freight rates and charges on all commodities, with a few exceptions. The authorized increase on anthracite was in direct relation to the present rate. Specifically, on the present rate of $1.00 or less the increase approved was 3 cents per net ton and 4 cents per gross ton; on the present rate of over $1.00 the increases authorized were 5 cents per net ton and 6 cents per gross ton. Authorization for the increases was issued by the Interstate Commerce Commission on March 2, 1942, and the charges may become effective not later than May 15, 1942. The increases as approved apply to the war period and 6 months thereafter.

The anthracite industry had no major labor disturbances in 1941, although several thousand miners in the lower fields, especially in the Lehigh region, were away from work for about a month. The dissatisfaction of the miners was a union matter and concerned union dues and assessments. The wage agreement between the anthracite mine operators and the United Mine Workers of America, effected in May 1939, expired April 30, 1941. After a 1-day suspension, a new contract was arranged between the operators and the mine workers. The agreement became effective May 1, 1941, and expires April 30, 1943. The miners were given a compensation payment, with 1 week's vacation, and also received a graduated percentage increase over the old wage scale.

Research at the Pennsylvania State College School of Mineral Industries, which was begun in 1939 when the Miller bill passed the Pennsylvania General Assembly, was continued. The Miller bill expired on May 31, 1941, but enactment of the Williams-Kenehan bill continued the work until May 31, 1943. Research also was continued within the industry, where special efforts are being made to

find new uses for anthracite and more efficient utilization of that fuel in modern coal-burning equipment.

Definition of Pennsylvania anthracite industry.—Based upon differences in composition and characteristics of the product, trade practice and historical usage recognize two major divisions in the coal industry of the United States—bituminous coal and Pennsylvania anthracite. Anthracite and semianthracite also are mined in parts of Virginia, Arkansas, Colorado, and New Mexico. Locally these coals represent distinct and important industries, but the tonnages involved are small and for statistical convenience usually are grouped with the totals of the bituminous-coal industry.

The Pennsylvania anthracite industry, as here defined, includes all nonbituminous fields of that State. Trade usage commonly includes the output of the Bernice Basin in Sullivan County with Pennsylvania anthracite, although the coal of this basin is classified officially as semianthracite.

Statistical trends.—Tables 1 and 2 present statistical data on the Pennsylvania anthracite industry.

The war and anthracite.—Pennsylvania anthracite contributes to the war program chiefly on the home front. It is primarily a domestic fuel and is used for heating homes and apartment houses, as well as for hot water and cooking purposes; moreover, Army camps are using considerable quantities. The homes of thousands of war workers are made comfortable by this fuel, which contributes in this way to the moral and physical well-being of those employed in vital industries. It has similar uses in Canada, to which the United States exports large quantities, mostly domestic sizes for heating homes and small apartment houses. Anthracite is also consumed by public utilities, railroads, and manufacturers connected directly or indirectly with the production of war materials.

The Pennsylvania anthracite industry would be able to increase its output substantially whenever necessary if there should be any disruption in the continued supply or flow of other fuels, such as bituminous coal, coke, and oil, to the New England and Middle Atlantic States. Many of the small heating plants in that area, which now burn coke or oil but at one time used anthracite, can be converted at relatively small expense to use that fuel again. Then too, the anthracite regions are much nearer the highly populated areas of the New England and Middle Atlantic States than are the bituminous-coal and oil fields; if allocation of fuels is necessary, as in the First World War, anthracite may be drafted for more extensive service in both domestic heating and industry, where these fuels are now used.

In November 1941 the President requested that the Secretary of the Interior act as Solid Fuels Coordinator to take care of many difficult problems of production, distribution, utilization, and transportation of solid fuels. The defense and Lease-Lend programs created a large increase in the demand for anthracite and bituminous coal, and it was these fuels with which the Office of Solid Fuels Coordination was primarily concerned. The Bureau of Mines has cooperated closely with that office in its work on anthracite.

TABLE 1.—*Statistical trends of Pennsylvania anthracite industry, 1937–41*

	1937	1938	1939	1940	1941
Production:					
Loaded at mines for shipment:					
Breakers .... net tons	44,016,915	39,010,935	[1] 43,660,662	[1] 43,800,127	46,864,422
Washeries .... do	1,837,879	1,679,509	1,766,384	1,761,942	2,538,692
Dredges .... do	348,350	373,425	565,236	613,884	1,008,983
Sold to local trade and used by employees .... do	2,981,391	2,722,206	3,081,073	3,052,626	3,695,125
Used at collieries for power and heat .... do	2,671,898	2,312,952	2,414,022	2,256,061	2,261,045
Total production .... do	51,856,433	46,099,027	51,487,377	51,484,640	56,368,267
Value at breaker, washery, or dredge	$197,599,000	$180,600,000	$187,175,000	$205,490,000	$240,275,000
Average sales realization per net ton on breaker shipments:					
Domestic:					
Lump and Broken	$5.08	$5.24	$4.63	$5.49	$5.72
Egg	$5.06	$5.18	$4.73	$5.32	$5.84
Stove	$5.21	$5.33	$4.84	$5.47	$5.93
Chestnut	$5.23	$5.36	$4.87	$5.49	$5.93
Pea	$4.01	$3.88	$3.65	$4.13	$4.50
Total domestic	$5.01	$5.10	$4.64	$5.24	$5.68
Steam:					
Buckwheat No. 1	$2.95	$3.03	$2.90	$3.18	$3.37
Buckwheat No. 2 (Rice)	$2.26	$2.35	$2.20	$2.35	$2.52
Buckwheat No. 3 (Barley)	$1.45	$1.61	$1.62	$1.68	$1.78
Other, including Buckwheat No. 4	$.79	$.87	$.91	$.92	$1.02
Total steam	$2.21	$2.33	$2.25	$2.41	$2.55
Total all sizes	$4.03	$4.16	$3.85	$4.27	$4.59
Percent by sizes in total breaker shipments:					
Domestic:					
Lump and Broken	0.4	0.3	0.6	0.3	0.3
Egg	5.7	5.4	5.2	4.5	4.2
Stove	22.1	23.7	24.1	24.1	24.3
Chestnut	26.2	26.0	25.8	25.9	25.5
Pea	10.8	10.6	11.0	11.1	10.8
Total domestic	65.2	66.0	66.7	65.9	65.1
Steam:					
Buckwheat No. 1	14.7	14.8	14.3	14.7	14.6
Buckwheat No. 2 (Rice)	7.9	7.7	7.8	7.8	8.2
Buckwheat No. 3 (Barley)	8.9	8.6	8.5	8.8	8.9
Other, including Buckwheat No. 4	3.3	2.9	2.7	2.8	3.2
Total steam	34.8	34.0	33.3	34.1	34.9
Producers' stocks on Dec. 31 [2] .... net tons	2,154,000	1,458,000	994,000	939,000	1,274,000
Exports .... do	1,914,000	1,909,000	2,590,000	2,668,000	[3] 2,416,000
Imports .... do	396,000	363,000	298,000	135,000	[3] 64,000
Consumption (calculated) .... do	50,400,000	45,200,000	49,700,000	49,000,000	[4] 53,700,000
Average number of days worked	189	171	183	186	203
Man-days lost on account of strikes and lock-outs	580,462	579,457	241,688	176,432	397,616
Number of men on strike during year	24,346	27,435	27,795	19,464	39,763

Average number of men employed	99,085	96,417	93,138	91,313	88,054
Output per man per day ... net tons	2.77	2.79	3.02	3.02	3.04
Output per man per year ... do	523	478	553	562	617
Quantity cut by machines ... do	1,984,512	1,588,407	1,881,884	1,816,483	1,855,422
Quantity mined by stripping ... do	5,696,018	5,095,341	5,486,479	6,352,700	7,316,574
Quantity loaded by machines underground ... do	10,683,837	10,151,669	11,773,833	12,326,000	13,441,987
Distribution:					
Total receipts in New England [5] ... do	'4,761,000	4,468,000	4,902,000	[6] 4,822,000	5,551,000
Exports to Canada ... do	1,893,000	1,896,000	2,577,000	2,627,000	(7)
Loaded into vessels at Lake Erie [8] ... do	674,000	450,000	531,000	430,000	536,000
Receipts at Duluth-Superior [9] ... do	296,000	155,000	202,000	138,000	253,000

[1] Includes small quantity of washery coal.
[2] Anthracite Committee. Figures represent prepared coal in ground storage. 1940 figures are through December 28 1941 figures are through December 27.
[3] Figures cover January to September, inclusive.
[4] Consumption calculated using imports and exports for 9 months only
[5] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[6] Revised figure.
[7] Not available.
[8] Ore and Coal Exchange, Cleveland, Ohio.
[9] U. S. Engineer Office, Duluth, Minn.

TABLE 2.—*Statistical summary of monthly developments in Pennsylvania anthracite industry in 1941*

[All tonnage figures represent net tons]

	1941														1940 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Year: Total	Year: Change from 1940 (percent)	
Production, including mine fuel, local sales, and dredge coal: Monthly total	5,162,000	4,596,000	4,765,000	3,317,000	4,001,000	5,072,000	4,855,000	5,441,000	5,334,000	5,580,000	3,974,000	4,271,000	56,368,000	+9.5	51,485,000
Shipments, breakers, and washeries only: [1] Monthly total, all sizes	4,210,156	3,808,336	3,856,734	2,674,168	3,563,905	4,573,788	4,093,880	4,763,599	4,347,808	4,374,251	3,166,083	3,366,111	46,798,819	+8.8	43,023,750
Distribution:															
Lake Erie loadings [2]				22,124	61,353	70,963	58,116	84,637	72,643	65,287	101,243	124	536,490	+24.7	430,192
Receipts at Duluth-Superior [3]					41,378	39,716	23,821	23,066	71,763	21,048	32,159		252,951	+83.7	137,688
Upper Lake dock trade: [4]															
Receipts:															
Lake Superior				74	41,379	41,959	24,529	15,173	71,824	21,049	28,383		244,370	+86.9	130,715
Lake Michigan	855	1,139	1,419	15,824	22,426	31,927	31,619	38,309	32,352	44,450	61,542	8,125	289,987	+2.7	282,475
Deliveries (reloadings):															
Lake Superior	18,379	12,868	5,368	7,102	18,091	27,279	21,448	15,769	17,488	14,274	21,561	14,485	194,112	−4.4	203,128
Lake Michigan	22,443	20,973	18,231	6,425	17,054	61,712	33,670	31,052	22,248	24,844	14,573	14,462	287,687	+1.3	283,870
Retail yards—164 selected dealers: Deliveries [4]	326,000	293,380	318,404	169,741	192,078	344,984	320,255	265,151	222,302	162,495	146,245	238,372	2,999,407		(5)
New England receipts: [6]															
By tide (including imports)	43,423	37,054	27,097	40,892	73,247	73,336	70,002	80,512	65,458	68,823	59,212	42,677	681,733	+5.2	648,027
By rail	419,106	388,874	388,268	225,338	405,214	452,746	439,695	537,413	499,971	481,393	358,411	273,211	4,869,640	+16.7	4,174,297
Exports [7]	163,379	177,930	201,201	109,018	346,193	375,720	250,088	340,479	452,096	(5)	(5)	(5)	(5)		2,667,632
Imports [7]	11,971	6,729	6,944	7,338	39	224	17,492	6,771	6,759	(5)	(5)	(5)	(5)		135,436
Industrial consumption by—															
Railroads (class I only) [8]	121,582	112,028	134,757	190,260	128,030	102,960	99,975	88,474	95,790	96,875	120,870	102,610	1,394,211	+1.1	1,379,075
Electric power utilities [9]	210,131	190,012	206,561	199,073	257,972	252,877	272,561	289,552	265,229	273,145	235,741	240,416	2,893,270	+19.3	2,425,134
Other industrial consumers [10]	106,788	101,008	111,889	110,896	95,514	104,396	81,103	112,671	93,062	89,141	117,046	131,168	1,254,682	+15.1	1,090,248
Number of industrial firms reporting [10]	75	83	76	85	76	76	73	71	71	69	73	72	(5)		(5)
Stocks at end of period shown:															
Railroads (class I only) [8]	132,493	131,564	134,078	138,660	103,685	100,885	87,546	117,778	172,616	216,977	239,465	238,871	238,871	+65.7	144,149
Electric power utilities [9]	1,252,751	1,234,429	1,217,678	1,189,760	1,178,164	1,210,485	1,263,568	1,357,305	1,317,242	1,371,655	1,338,915	1,257,478	1,257,478	+3.4	1,216,695

Other industrial consumers [10]	167, 411	196, 446	226, 550	227, 018	213, 524	229, 756	205, 221	277, 330	265, 999	230, 578	254, 635	288, 526	288, 526	+26. 2	228, 583
Stocks on Upper Lake docks: [4]															
Lake Superior	59, 331	47, 104	41, 761	33, 933	54, 704	69, 093	72, 171	71, 165	125, 499	132, 273	139, 092	124, 603	124, 603	+60. 3	77, 714
Lake Michigan	118, 668	98, 833	81, 210	91, 366	96, 738	66, 928	64, 861	72, 118	82, 223	101, 829	155, 460	149, 124	149, 124	+6. 3	140, 256
Retail stocks—164 selected dealers [4]	338, 797	277, 944	248, 206	269, 451	331, 353	341, 606	331, 448	410, 286	456, 469	502, 544	532, 196	484, 036	484, 036	+30. 5	370, 964
Prices at mines, average per net ton: [11]															
Company Stove	$6. 25	$6. 25	$6 25	$6 25	$6 25	$6. 33	$6. 40	$6. 54	$6. 71	$6. 75	$6. 75	$6. 75	$6. 46	+5. 6	$6. 12
Company Buckwheat No. 1	$3. 50	$3. 50	$3. 50	$3 50	$3. 60	$3. 75	$3. 75	$3. 75	$3. 75	$3. 75	$3. 75	$3. 75	$3. 65	+4. 3	$3. 50
Wholesale prices: [12]															
On tracks, destination:															
Chestnut	$9 83	$9 83	$9 81	$9 81	$9 79	$9 81	$9 95	$10. 10	$10. 25	$10. 30	$10 30	$10. 29	$10. 01	+4. 8	$9 55
Pea	$8. 40	$8. 40	$8 40	$8 39	$8 36	$8 41	$8. 56	$8. 68	$8. 83	$8. 89	$8 89	$8 89	$8. 59	+5. 0	$8. 18
Index numbers (1926=100)	81. 1	81. 1	81 0	80. 9	80 7	81 0	82. 2	83 3	84. 5	85 3	85. 3	85 3	82. 7	+4. 8	78. 9
Labor conditions [13]															
Average weekly earnings	$25. 13	$29. 35	$27. 79	$16 43	$22 59	$34. 20	$23. 25	$3 . 56	$32. 60	$32 12	$27. 38	$24 05	$27. 41	+9. 9	$24. 95
Index of employment (1929 average=100)	50. 3	50. 6	50. 2	48. 7	48. 6	49. 2	49 3	50. 0	50 0	50. 3	50 2	49. 1	49. 7	−2. 0	50. 7
Index of pay-roll totals (1929 average=100)	38. 5	45. 2	42. 4	24 3	33 4	51 2	34. 8	51. 1	49. 6	49. 2	41. 8	35 9	41 4	+7. 5	38. 5

1 Furnished by Anthracite Institute. Rail shipments only.
2 Ore and Coal Exchange, Cleveland, Ohio.
3 U. S. Engineer Office, Duluth, Minn.
4 Bituminous Coal Division, U. S. Department of the Interior.
5 Data not available.
6 Furnished by Commonwealth of Massachusetts, Division on the Necessaries of Life. Figures for 1941 preliminary.
7 Department of Commerce.
8 Association of American Railroads.
9 Federal Power Commission.
10 National Association of Purchasing Agents.
11 Computed from weekly quotations from trade journals. Figures represent circular prices quoted on white ash by leading anthracite-producing companies.
13 Bureau of Labor Statistics.

Anthracite program.—Producers whose output comprised a large proportion of the total tonnage of the anthracite industry continued to operate under the voluntary production-control program inaugurated early in 1940 and sponsored by the Commonwealth of Pennsylvania, the operators, and the United Mine Workers of America.

In accordance with the Act of General Assembly No. 125, July 1941, the Commonwealth of Pennsylvania, Department of Commerce, having received petitions signed by producers whose output was more than 95 percent of the total anthracite production and by the United Mine Workers of America, adopted the Anthracite Emergency Program as a production-control plan for the anthracite industry. The order became effective November 10, 1941, when the Secretary of the Pennsylvania Department of Commerce began to administer the program. The Anthracite Emergency Committee is now known as the Anthracite Committee.

For several years before the plan was adopted, the industry was in a demoralized state owing to inroads of other fuels and keen competition for the anthracite markets within the industry itself. The primary purpose of the plan was to create some degree of stabilization within the industry and to bring production in closer alinement with current demand. The plan is credited with having helped to bring about this condition. The illicit or "bootleg" mining of anthracite and its marketing created a highly unfavorable condition in the hard-coal regions and in the market territory where the coal was sold. The Anthracite Committee has helped to alleviate this problem by making arrangements for the legitimate industry to buy the "bootleg" product and wherever possible to employ former miners of illicit coal.

Federal Anthracite Coal Commission.—In December 1941 the President approved House Joint Resolution No. 255 creating the Federal Anthracite Coal Commission. The Commission was composed of two members of the Senate, two members of the House of Representatives, the Director of the Federal Bureau of Mines, an employee of the National Resources Planning Board, and an employee of the Interstate Commerce Commission. The Commission was to determine facts relating to and investigate ways and means for improving economic conditions in the anthracite-producing regions of the United States. After hearings in the Pennsylvania anthracite regions and study of special reports from Federal, State, and local Government agencies, civic organizations, and private citizens, the Commission in April 1942 submitted its report to the President and the Congress. The report contained recommendations for both short-term and long-term measures of improvement.

Recommendations for immediate improvement called attention to the unused manpower and housing facilities in the anthracite regions and suggested that consideration be given to the establishment of war plants and industries of more permanent nature. Vocational schools were mentioned as a means of educating persons in the specialized training required by war industries. The report urged that surveys of mine flooding should be pressed to completion and that the industry should continue development of stokers and automatic equipment and investigate ways to expand industrial uses for anthracite.

As regards long-term improvement, it was suggested that a Federal Bureau of Mines research station be established in the anthracite area to develop new and extended uses for anthracite, study methods of mining, and coordinate activities of Pennsylvania State and local agencies with those of the United States Government. It was also suggested than an economic survey be made concerning the possibilities of reforesting the anthracite area and that an agency be created to deal with economic problems resulting from gradual depletion of anthracite reserves.

Illicit coal.—The illicit or "bootleg" mining of anthracite, which was begun in the early 1930's when unemployed miners dug coal from land owned by anthracite-operating companies, continued in 1941, when about 5 million tons of coal were produced by activity of this type. In 1936 illicit production totaled about 2½ million net tons; and, according to the Anthracite Institute, that for 1940 totaled more than 4 million tons. Early in 1941 the Anthracite Committee adopted a plan, the successful operation of which it was hoped would eliminate this kind of mining. For example, it provided that any cooperating producer may make lawful arrangements to purchase the output of a "bootleg" hole or holes in addition to his own quota (assigned under the emergency program), which will not be affected thereby. Coal bought in accordance with this agreement is included in the production statistics of this chapter. The plan provided also that cooperating producers may employ former "bootleggers," and such producers are granted a supplemental allocation equal to 3¼ net tons per man per day of commercial output for each man so employed.

According to a survey by the Anthracite Emergency Committee (now the Anthracite Committee) in March 1941, 10,762 men were working in 3,006 "bootleg" holes, whereas in May 1942 a comparable survey revealed 7,554 men employed in 2,029 holes—a reduction of 30 percent in men and 33 percent in the number of holes being operated. Some of this decrease probably can be attributed to efforts of the Anthractie Committee to eliminate this undersirable type of mining. Then, too, the heavy demand for men due to the accelerated industrial activity and restrictions on automotive equipment undoubtedly has tended to decrease the mining of "bootleg" coal. It is expected that the output from illicit mines will be much less in 1942 than in 1941.

Research and technologic developments.—The annual anthracite conferences have been recessed for the duration of the war because of the present great demands on the time of technical men. The fifth such conference was originally scheduled to be held at Lehigh University on May 7 and 8, 1942. Many fine papers on research and technologic developments in the anthracite industry have been presented at these conferences in the past. The fourth annual conference, at Bethlehem in May 1941, is discussed briefly in Minerals Yearbook, Review of 1940.

The cooperative research program, sponsored by the Commonwealth of Pennsylvania and the anthracite industry at the Pennsylvania State College, was continued. Among other subjects, special attention was paid to the use of anthracite in water-gas generators and the preparation of activated carbon from Pennsylvania anthracite.

Experiments concerning the resistance of anthracite to mechanical and thermal shock were also conducted.

In the nineteenth century, anthracite was employed extensively in foundries and blast furnaces as metallurgical fuel; in 1890 alone, 2,186,411 gross tons of pig iron were made using anthracite as fuel. Considerable research and experiments have been under way within the industry for the last several years in an attempt to revive this one-time important industrial use for anthracite. Experiments also are being conducted on the possibility of using anthracite culm and ashes in the manufacture of lightweight aggregate to be used in concrete construction materials. Studies are being made concerning the use of anthracite for soil improvement and the production of mineral wool from anthracite culm and ashes.

Anthracite Industries, Inc., conducted extensive investigations concerning oil-burner installations and factors to be considered in connection with conversion from oil to anthracite, with special reference to the possible shortage of petroleum products along the Atlantic seaboard. Research was continued in the Anthracite Industries laboratory on more efficient utilization of anthracite in automatic burning equipment.

Anthracite Institute.—The Anthracite Institute, through its information services, kept the industry informed on many Federal, State, and local matters concerning anthracite. Members of the institute staff appeared before various groups in the interest of the anthracite industry. It was particularly active in voicing its opposition to hydroelectric projects that might interfere with the consumption of anthracite and also actively disapproved the extension of natural-gas lines into the primary anthracite markets.

Distribution.—During the First World War, the distribution of Pennsylvania anthracite in the United States covered a wider area than in 1941. In the coal year 1916–17 anthracite was shipped to 44 States and to the District of Columbia, whereas in the calendar year 1941, according to the Pennsylvania State Department of Mines, shipments were made to 42 States and to the District of Columbia. Not only has the area of distribution changed, but the percentage of shipments to various sections has definitely changed. For the coal year 1916–17 the New England and Middle Atlantic States received 75 percent of the total anthracite shipped to destinations in the United States, whereas in 1941 this same group of States received 94 percent. Details of anthracite distribution for the coal year 1916–17 and the calendar year 1941 are given in tables 3 and 7.

According to the Commonwealth of Massachusetts, Division on the Necessaries of Life, rail receipts of Pennsylvania anthracite in New England in 1941 were 4,869,640 net tons. Tidewater receipts in 1941, including imports during the first 9 months of the year, were 681,733 tons. Table 4 gives details of anthracite movement into New England.

TABLE 3.—*Pennsylvania anthracite sold in coal year April 1, 1916, to March 31, 1917, in net tons*

Consuming States	Domestic sizes, including pea	Steam sizes	Total	Percent of total
Middle Atlantic States:				
Pennsylvania	8, 109, 089	5, 512, 244	13, 621, 333	
New York	15, 870, 681	6, 780, 216	22, 650, 897	57. 3
New Jersey	5, 320, 870	4, 594, 287	9, 915, 157	
	29, 300, 640	16, 886, 747	46, 187, 387	57. 3
New England States:				
Maine	630, 808	3, 725	634, 533	
New Hampshire	352, 326	173, 207	525, 533	
Vermont	349, 374	47, 779	397, 153	
Massachusetts	5, 636, 662	396, 282	6, 032, 944	13 4
Rhode Island	739, 652	79, 458	819, 110	
Connecticut	2, 240, 041	108, 970	2, 349, 011	
	9, 948, 863	809, 421	10, 758, 284	13. 4
South Atlantic and Southern States.				
Alabama	1, 084		1, 084	
Arkansas	998		998	
Delaware	250, 779	23, 890	274, 669	
District of Columbia	590, 087	18, 020	608, 107	
Florida	9, 586	9, 009	18, 595	
Georgia	24, 977	52	25, 029	
Kentucky	10, 154		10, 154	
Louisiana	7, 007		7, 007	
Maryland	1, 045, 557	36, 261	1, 081, 818	3 0
Mississippi	681		681	
North Carolina	29, 910	123	30, 033	
Oklahoma	808		808	
South Carolina	26, 290		26, 290	
Tennessee	4, 423	638	5, 061	
Texas	7, 781		7, 781	
Virginia	265, 868	5, 093	270, 961	
West Virginia	17, 490	47, 807	65, 297	
	2 293, 480	140, 893	2, 434, 373	3 0
North Central States:				
Illinois	2, 639, 102	167, 265	2, 806, 367	
Indiana	512, 234	5, 056	517, 290	
Iowa	469, 010	2, 684	471, 694	
Kansas	19, 746	928	20, 674	
Michigan	1, 782, 145	15, 930	1, 798, 075	
Minnesota	1, 177, 898	149, 152	1, 327, 050	
Missouri	197, 882	660	198, 542	12 5
Nebraska	177, 610	215	177, 825	
North Dakota	271, 509	11, 750	283, 259	
Ohio	649, 914	18, 144	668, 058	
South Dakota	236, 835	3, 463	240, 298	
Wisconsin	1, 343, 953	201, 537	1, 545, 490	
	9, 477, 838	576, 784	10, 054, 622	12. 5
Western States:				
California	1, 175		1, 175	
Colorado	477		477	
Idaho	460		460	
Montana	9, 887	67	9, 954	[1]
Oregon	143		143	
Washington	1, 845		1, 845	
Wyoming	159		159	
	14, 146	67	14, 213	[1]
Total distribution in United States for purposes other than railroad fuel	51, 034, 967	18, 413, 912	69, 448, 879	86. 2
Used for railroad fuel	2, 779, 564	3, 653, 978	6, 433, 542	7. 9
Miscellaneous	10, 656	37, 238	47, 894	. 1
Total distribution in United States	53, 825, 187	22, 105, 128	75, 930, 315	94. 2
Exports:				
Canada	4, 318, 744	271, 849	4, 590, 593	
Newfoundland	5, 419		5, 419	5. 8
Other exports	42, 087		42, 087	
	4, 366, 250	271, 849	4, 638, 099	5. 8
Total distribution	58, 191, 437	22, 376, 977	80, 568, 414	100. 0
Total shipments by railroad companies			75, 909, 780	

[1] Less than 0.1 percent.

TABLE 4.—*Receipts of anthracite in New England, 1917, 1920, 1923, and 1927–41, in thousands of net tons*

Year	Receipts by tide [1]						Receipts by rail [1]	Imports [2]	Total receipts of Pennsylvania anthracite [3]
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total			
1917	432	47	2,222	555	1,165	4,421	7,259	1	11,679
1920	307	6	2,015	450	743	3,521	7,804	1	11,324
1923	437	27	2,216	511	891	4,082	8,102	145	12,039
1927	242	33	1,220	311	615	2,421	6,725	106	9,040
1928	205	35	1,373	301	528	2,442	6,934	369	9,007
1929	237	17	1,227	329	450	2,260	6,781	483	8,558
1930	275	17	1,236	271	422	2,221	6,169	658	7,732
1931	164	18	1,125	282	348	1,937	5,125	611	6,451
1932	148	10	1,014	212	275	1,659	3,980	574	5,065
1933	195	7	1,027	202	259	1,690	3,562	443	4,809
1934	168	20	946	190	266	1,590	4,382	477	5,495
1935	121	7	802	205	237	1,372	4,030	559	4,843
1936	127	14	792	198	267	1,398	3,889	612	4,675
1937	81	11	604	152	200	1,048	3,713	395	4,366
1938	93	2	554	137	191	977	3,491	363	4,105
1939	74	3	488	83	227	875	4,027	298	4,604
1940 [4]	48	4	350	74	172	648	4,174	135	4,687
1941 [5]	57	9	348	58	210	682	4,870	[6] 64	5,488

[1] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[2] Department of Commerce.
[3] Total receipts by rail and by tide less imports.
[4] Revised figures.
[5] Preliminary figures.
[6] Figures cover January to September, inclusive.

Loadings at Lake Erie ports increased from 430,192 net tons in 1940 to 536,490 in 1941, or 25 percent. Receipts at Duluth-Superior increased 84 percent and those on the Upper Lake docks 29 percent.

Figure 1 illustrates graphically shipments of anthracite from the Lehigh, Schuylkill, and Wyoming regions, 1850–1940.

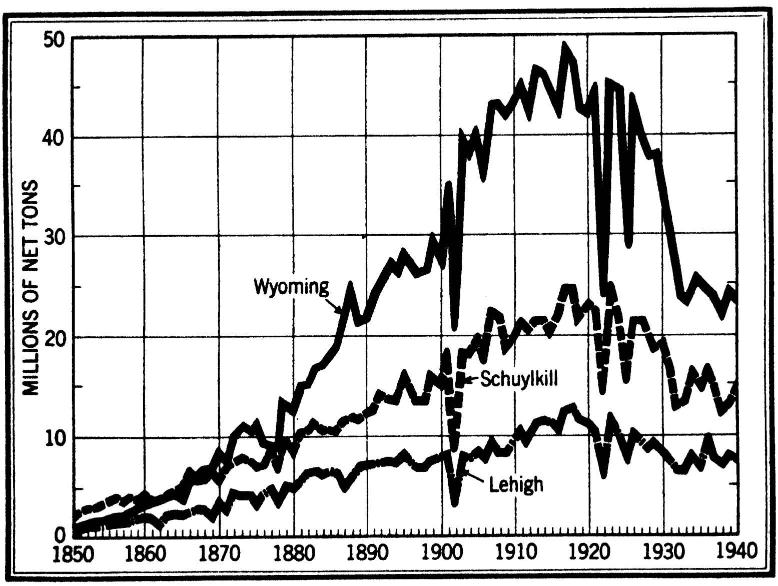

FIGURE 1.—Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850–1940.

Competitive fuels in the United States and in principal markets.—The principal anthracite markets today are the New England States, New York, New Jersey, Pennsylvania, Maryland, Delaware, and the District of Columbia. Data on the consumption of all fuels in these markets are not available; however, the apparent consumption of anthracite, coke, briquets, and heating and range oils, in terms of anthracite, amounted to 80,615,000 net tons in 1940. The sales of heating and range oils in this area in 1940 were the equivalent of 32,543,000 tons of coal, and the mine shipments of anthracite to these States were 43,718,000 tons. According to the Pennsylvania State Department of Mines, anthracite shipments in 1941, rail and truck, to this area totaled 47,466,000 tons. In addition, considerable quantities of "bootleg" or illicit coal were shipped into these markets. The demand for coke for metallurgical use was chiefly responsible for the decline in its consumption for domestic heating from 4,052,000 tons in 1940 to 3,688,000 tons in 1941. Details are shown in table 5.

In general, the supplies of fuel commonly used for space-heating purposes in the United States increased in 1941 over 1940. The increase in anthracite was quite pronounced, but estimates for sales of heating and range oils show only minor gains when compared with the large increase in 1940 over 1939. Sales of byproduct and beehive coke for domestic heating decreased about 19 percent in 1941 compared with 1940. Details on the supplies of various fuels are given in table 6.

Transportation of anthracite to principal markets.—Anthracite all-rail and truck shipments from the mine to destinations in the United States increased 8 percent in 1941 over 1940, according to data compiled from records of the Pennsylvania State Department of Mines. Rail shipments increased 6 percent; truck shipments, 22 percent. Of the total shipments in 1941, the railroads hauled 85 percent and trucks 15 percent. In 1940, of the total shipments, 86 percent moved by rail and 14 percent by truck; in 1939 the percentages were 89 and 11 percent, respectively.

Pennsylvania received 66 percent of the total truck shipments in 1941; New Jersey and New York followed with 18 and 14 percent, respectively. It is also of interest to note that of the 7,529,479 tons trucked in 1941, 3,252,787 tons were handled in January, February, March, and December.

The trucking of anthracite from the mines has more than doubled since 1936, when the tonnage totaled 3,177,656. It is questionable, however, whether transportation by this method will continue throughout 1942 at the 1941 rate with war restrictions on rubber tires and other vital materials.

The distribution of rail shipments of anthracite, by States of destination, for 1939–41 is shown in table 7, and truck movement of Pennsylvania anthracite by months in 1941, by States of destination, in table 8.

TABLE 5.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1938–41*

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Delaware	Maryland	Pennsylvania	District of Columbia	Total: Thousands of net tons	Total: Percent of total fuels
Anthracite:									
All users: [1]									
1938	3,553	[2] 13,452	[2] 6,421	198	574	9,603	254	34,055	55.0
1939	4,492	[2] 16,716	[2] 9,060	259	634	12,077	264	43,502	58.2
1940	4,539	[2] 16,249	[2] 8,814	304	608	12,915	289	43,718	54.2
1941	5,540	[2] 16,308	[2] 10,190	361	681	14,103	283	47,466	(3)
Imports: [4]									
1938	363							363	.6
1939	298							298	.4
1940	135							135	.2
1941 [4]	64							64	(3)
Briquets:									
Domestic use:									
1938	38	27	1		3	11		80	.1
1939	46	23	1		2	11	1	84	.1
1940	52	26	1	(5)	2	10	(5)	91	.1
1941	52	25	1	(5)	3	14	(5)	95	(3)
Imports: [4]									
1938	14							14	(6)
1939	1							1	(6)
1940									
1941 [4]									
Coke:									
Domestic use.									
1938 [7]	1,018	1,604	395	5	7	563	1	3,593	5.8
1939 [7]	1,077	1,606	413	5	7	596	2	3,706	5.0
1940	1,430	1,564	489	2	28	537	2	4,052	5.0
1941	1,363	1,350	470	1	28	474	2	3,688	(3)
Imports: [4]									
1938	21	7						28	.1
1939	12	19						31	.1
1940	15	58			3			76	.1
1941 [4]	64	37			107			208	(3)
Oil:									
Heating and range: [8]									
1938	9,649	7,677	3,269	101	591	2,052	406	23,745	38.4
1939	10,787	8,967	3,770	107	694	2,279	458	27,062	36.2
1940	13,027	10,726	4,503	120	885	2,704	578	32,543	40.4
1941	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total fuel: [9]									
1938	14,656	22,767	10,086	304	1,175	12,229	661	61,878	100.0
1939	16,713	27,421	13,244	371	1,337	14,963	725	74,774	100.0
1940	19,198	28,623	13,807	426	1,526	16,166	869	80,615	100.0
1941	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

[1] Pennsylvania Department of Mines; illicit coal not included.
[2] An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped to New York City.
[3] Data not yet available.
[4] Department of Commerce; 1941 totals cover January to September, inclusive.
[5] Less than 1,000 tons.
[6] Less than 0.05 percent.
[7] Estimated upon basis of distribution in 1936.
[8] Converted to coal equivalent upon basis of 4 barrels of fuel oil equaling 1 ton of coal.
[9] Excludes bituminous coal.

Consumption.—War-time restrictions limit the publication of import and export statistics for 1941 to the first 9 months of the year. Taking this into consideration and making allowances for changes in producers'stocks, the consumption of anthracite in the United States in 1941 amounted to 53,700,000 net tons, an increase of about 4,700,000 tons over the calculated consumption in 1940. Changes in retail dealers, and small consumers' stocks are not included in these calculations, as data on variations are insufficient. Class I railroads and electric power utilities consumed 4,287,481 net tons of anthracite in 1941 compared with 3,804,209 tons in 1940.

TABLE 6.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1938–41*

[Wherever available, figures represent quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic purposes, total production (or imports) is shown to indicate trend of growth]

	1924	1938	1939	1940	1941
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	56,576,296	28,206,508	29,504,632	29,076,573	30,912,649
Shipments of Buckwheat No. 1 [1]	9,510,508	6,159,006	6,569,902	6,771,387	7,357,542
Shipments of smaller steam sizes [1]	11,160,695	8,698,355	9,917,748	10,327,993	12,141,906
Local sales	3,043,939	2,722,206	3,081,073	3,052,626	3,695,125
Total commercial production	80,291,438	43,786,075	49,073,355	49,228,579	54,107,222
Exports	4,017,785	1,908,911	2,590,000	2,667,632	[2] 2,416,104
Imports for consumption (chiefly from United Kingdom and U. S. S. R.)	117,951	362,895	298,153	135,436	[2] 64,267
Fuel briquets [3]	580,508	868,382	880,981	1,027,585	[4] 1,271,413
Packaged-fuel production		160,952	215,507	284,513	269,844
Coke:					
Byproduct sales for domestic use	2,812,771	7,129,384	7,549,937	8,131,947	6,596,969
Beehive sales for domestic use	139,886	93,306	88,204	99,066	85,990
Imports for consumption	82,833	135,240	141,911	112,550	[2] 241,690
Gas-house-coke sales [5]	1,400,000	342,300	362,000	(6)	(6)
Petroleum-coke production	761,100	1,602,200	1,666,400	1,526,600	1,648,800
Anthracite and semianthracite production outside of Pennsylvania	704,513	370,665	(6)	(6)	(6)
Lignite production [7]	2,255,385	2,997,921	3,042,537	2,939,201	(6)
Bituminous-coal sales for domestic use	(8)	(8)	(8)	(8)	(8)
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil	(6)	33,707,000	[9] 37,061,000	[9] 44,692,000	[4] 45,700,000
Heating oils: [10]					
Domestic	5,021,000	118,323,000	[9] 136,232,000	[9] 160,379,000	[4] 163,500,000
Commercial	(6)				
Liquefied petroleum gases, domestic	(6)	1,377,000	2,084,000	3,191,000	5,255,000
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use [11]	285,152	482,068	[9] 509,487	[9] 578,290	[4] 590,000
Manufactured-gas sales for—[12]					
Domestic use	(6)	195,887	192,338	[9] 198,752	198,700
House heating	(6)	47,634	55,561	[9] 68,498	67,151

[1] A considerable part of Buckwheat No. 1 and smaller steam sizes is used by industries, railroads, and public utilities.
[2] Figures cover January to September, inclusive.
[3] Production plus imports less exports. Import and export figures for 1941 cover January to September, inclusive.
[4] Subject to revision.
[5] Partly estimated.
[6] Data not available.
[7] An estimated one-half is used for domestic purposes.
[8] Exact data not available; estimated between 55 and 77 million tons a year, including lignite and anthracite and semianthracite outside of Pennsylvania, shown separately.
[9] Revised figures.
[10] Includes all grades of fuel oil used for heating buildings.
[11] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[12] American Gas Association.

Changes in stocks.—Producers' stocks totaled 1,273,788 net tons on December 27, 1941, and 939,227 tons on December 28, 1940.

Stocks held by 164 selected retail dealers totaled 338,797 tons in January, reached a low of 248,206 tons in March, and increased to a high of 532,196 tons in November.

TABLE 7.—*Shipments of Pennsylvania anthracite, 1939–41, by destinations, in net tons* [1]

[Truck shipments excluded]

Destination	1939	1940	1941
New England States	4,489,970	4,539,026	5,539,936
New York	16,251,195	15,477,318	15,269,752
New Jersey	8,494,964	7,906,071	8,858,652
Pennsylvania	8,407,564	8,569,913	9,168,068
Delaware	194,759	197,456	234,454
Maryland	592,627	570,771	627,936
District of Columbia	256,936	280,415	271,921
Virginia	108,418	106,713	118,805
Ohio	112,833	113,553	119,710
Indiana	98,090	83,539	86,809
Illinois	277,166	265,424	281,548
Wisconsin	355,291	347,223	320,500
Minnesota	93,367	61,203	75,334
Michigan	245,519	203,299	247,703
Other States	66,217	68,372	52,223
Total United States	40,044,916	38,790,296	41,273,351
Canada	2,441,070	2,312,531	[2] 2,106,299
Other foreign countries	4,456	2,525	[2] 9,431
Grand total	42,490,442	41,105,352	43,389,081

[1] Pennsylvania Department of Mines
[2] January to September, inclusive

TABLE 8.—*Truck shipments of Pennsylvania anthracite by months in 1941, by States of destination, in net tons* [1]

Destination	January	February	March	April	May	June	July
Pennsylvania:							
Within region	385,677	370,326	369,683	173,014	171,723	210,642	162,722
Outside region	170,651	204,562	200,722	93,886	120,082	172,945	157,021
New York	104,881	100,387	103,508	42,552	54,979	96,185	84,803
New Jersey	120,875	116,912	114,787	41,708	68,298	122,819	114,717
Maryland	4,012	6,454	4,014	963	770	5,437	6,592
Delaware	16,264	16,076	13,631	5,016	5,603	9,526	11,936
District of Columbia	1,170	1,247	1,317	752	488	12	825
Other States	1,724	1,528	1,143	897	3,045	4,088	1,692
Total: 1941	805,254	817,492	808,805	358,788	424,988	621,654	540,308
1940	750,253	576,073	623,967	503,276	384,929	294,215	293,417

Destination	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region	210,484	211,917	233,360	240,396	340,708	3,080,652	40.9
Outside region	157,624	148,436	166,264	114,696	146,981	1,853,870	24.6
New York	107,486	86,311	82,195	72,001	102,878	1,038,166	13.8
New Jersey	121,372	113,617	102,364	81,952	211,952	1,331,373	17.7
Maryland	7,351	5,811	5,598	3,082	3,341	53,425	.7
Delaware	10,907	11,210	10,755	7,523	8,713	127,160	1.7
District of Columbia		1,582	1,630	799	883	10,705	.1
Other States	1,964	2,994	6,072	3,201	5,780	34,128	.5
Total. 1941	617,188	581,878	608,238	523,650	821,236	7,529,479	100.0
1940	351,544	487,681	601,285	591,567	733,860	6,192,067	100.0

[1] Compiled from reports of Pennsylvania Department of Mines.

On December 31, 1941, stocks of anthracite held by railroads (class I only), electric power utilities, and other industrial consumers amounted to 1,784,875 net tons, compared with 1,589,427 tons on the same date in 1940. Stocks held by the railroads increased 66 percent followed in order, with smaller increases, by other industrial consumers and electric power utilities.

The stocks of anthracite on the Upper Lake docks on December 31, 1941, amounted to 273,727 net tons—a substantial increase from the 217,970 tons on this date in 1940.

Trend of employment.—The average number of men employed in the Pennsylvania anthracite industry in 1941 was 88,054, which is comparable with a total of 91,313 men in 1940. Men working in "bootleg" or illicit mining are not included in these figures.

Trend of prices.—Circular f. o. b. mine prices as quoted by leading anthracite-producing companies in trade journals were firm throughout 1941 and contrasted sharply with the chaotic price situation in 1939. The prices in January 1941 were as follows: For Broken, Egg, Stove, and Chestnut, $6.25 a net ton; for Pea, $4.75 a ton. In June, prices on these sizes advanced 10 cents a ton, and additional increases in July, August, and September raised them to $6.75 a ton for Broken, Egg, Stove, and Chestnut and $5.25 a ton for Pea. At the close of 1941, the prices for these sizes had not changed from the September quotations. In January, Buckwheat, Rice, and Barley were quoted at $3.50, $2.75, and $2.00 a ton, respectively. In May the prices on these sizes advanced to $3.75, $2.90, and $2.15 a ton and were still at this level when the year ended.

During 1941 several conferences concerning anthracite prices were held between representatives of the anthracite industry and members of the Office of Price Administration. After the September advance in prices, the producers agreed to make no further increases without consulting the Office of Price Administration.

According to the Bureau of Labor Statistics, Department of Labor, the retail prices for Stove size on December 15, 1940, in Boston, New York City, Buffalo, Philadelphia, and Washington, D. C., were $13.75, $11.72, $11.72, $10.40, and $12.95 a net ton, respectively. On the same date in 1941, comparable prices were $14.50, $12.35, $12.38, $11.64, and $13.70 a ton. At the same periods, the prices for Buckwheat No. 1 in these cities were $10.00, $8.38, $8.48, $7.75, and $9.60 in 1940 compared with $11.00, $8.48, $8.73, $8.50, and $10.00 in 1941.

The prices apply to a net ton of 2,000 pounds except in the District of Columbia, where the gross ton of 2,240 pounds is used. New York City prices include a 2-percent sales tax in 1940 and 1 percent in 1941.

Sales realization.—The average realization on breaker shipments increased from $4.27 a net ton in 1940 to $4.59 in 1941, an increase of 7 percent. The average value per net ton of the total anthracite production in 1941 was $4.26 compared with $3.99 in 1940.

Imports and exports.—As previously mentioned, war restrictions permit publication of import and export statistics on anthracite in 1941 for the first 9 months only. For the January–September period of 1941, exports of Pennsylvania anthracite amounted to 2,416,104 net tons valued at $19,657,920. Exports for the entire calendar year 1940 totaled 2,667,632 tons valued at $21,210,499. Imports of anthracite for the first 9 months of 1941 amounted to 64,267 net tons, whereas in the entire calendar year 1940 imports were 135,436 tons. In both periods all the imported coal came from Canada and the United Kingdom. (See tables 36 and 37.)

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Mechanical stokers and oil burners.—According to the Bureau of the Census, Department of Commerce, factory sales of mechanical stokers for burning anthracite increased 28 percent in 1941 over 1940. Sales of class 1 stokers (capacity under 61 pounds of coal an hour) increased from 12,837 units in 1940 to 17,110 units in 1941. Sales of class 2 stokers (capacity 61 to 100 pounds of coal an hour) decreased from 970 units in 1940 to 599 in 1941.

In 1941, 303,869 oil burners were shipped compared with 264,232 in 1940—an increase of 15 percent. These figures include both domestic and foreign shipments but do not include burners used in ranges, stoves, water heaters, and space heaters.

SOURCES AND ACKNOWLEDGMENTS

Final statistics of the Pennsylvania anthracite-mining industry are prepared from an annual canvass, by mail, of all known legitimate anthracite operations that are active producers. More than 95 percent of the tonnage is reported direct, and the remainder is collected by personal visits or from reliable collateral evidence. The data on individual operations furnished by the producers are voluntary and confidential, as is customary in the statistical services of the Bureau of Mines.

In assembling available detailed information, free use has been made of pertinent figures prepared by the Anthracite Institute, the Anthracite Committee, the American Association of Railroads, and the Pennsylvania Department of Mines; the cordial and continued cooperation of all of these and of others from whom information has been received is gratefully acknowledged. Especial thanks are also due to the producers for reporting so promptly and, in general, so fully regarding their operations during 1941.

PRODUCTION

The output of Pennsylvania anthracite in 1941 totaled 56,368,267 net tons—a substantial increase over the 51,484,640 net tons produced in 1940. For historical comparison, these figures include a small amount of semianthracite produced in Sullivan County (37,020 net tons in 1941). Included also is the production of river coal, which is recovered by dredging from the streams draining the anthracite fields. This source supplied 1,517,563 net tons in 1941.

Before 1941 the Bureau had not considered the production of "bootleg" or illicit coal in its statistics on the Pennsylvania anthracite industry. The output from unauthorized mines has been considerable, and in 1941 totaled about 5,000,000 tons, of which about 2,000,000 tons were purchased by the legitimate industry and included in the production statistics in this chapter. In an effort to eliminate this undesirable condition, the legitimate industry (through the Anthracite Committee) decided upon a plan whereby it would lawfully buy the output from "bootleg" holes and at the same time attempt to employ the miners working the "bootleg" operations in the legitimate mines. This plan was put into effect in the first part of 1941; during the course of the year, the legitimate operators purchased run-of-mine coal from the bootleggers and shipped 1,902,481 tons of the prepared product to market. It would be very difficult if not impossible to segregate this purchased "bootleg" production from the output of

the legitimate industry, and it is therefore included in the various production tables in this chapter. Because of the inclusion of this quantity of illicit coal, the production statistics for 1941 are not exactly comparable with previous years. No attempt has been made to include in the statistics any other illicit coal than that purchased by legitimate operators.

Weeks and months.—Tables 9 and 10 summarize the statistics of weekly and monthly production of anthracite. Statistics of current output are estimated from records of car loadings and other pertinent data. The weekly and monthly figures in tables 9 and 10 have been adjusted to the annual total ascertained by direct canvass of the operators.

TABLE 9.—*Estimated weekly production of Pennsylvania anthracite in 1941, in net tons*

Week ended—	Net tons	Week ended—	Net tons
Jan. 4	[1] 377,000	July 19	1,314,000
11	1,095,000	26	1,330,000
18	1,228,000	Aug. 2	1,299,000
25	1,304,000	9	1,335,000
Feb. 1	1,234,000	16	1,218,000
8	1,183,000	23	1,305,000
15	1,262,000	30	1,279,000
22	983,000	Sept. 6	1,262,000
Mar. 1	1,130,000	13	1,281,000
8	1,161,000	20	1,183,000
15	1,137,000	27	1,194,000
22	1,146,000	Oct. 4	1,088,000
29	1,124,000	11	1,329,000
Apr. 5	679,000	18	1,279,000
12	657,000	25	1,269,000
19	611,000	Nov. 1	1,063,000
26	715,000	8	1,090,000
May 3	1,097,000	15	1,105,000
10	860,000	22	907,000
17	904,000	29	838,000
24	871,000	Dec. 6	804,000
31	1,082,000	13	863,000
June 7	1,167,000	20	1,094,000
14	1,325,000	27	871,000
21	1,255,000	Jan. 3, 1942	[1] 639,000
28	1,314,000		
July 5	64,000	Calendar year	56,368,000
12	1,164,000		

[1] Figures represent output of working days in that part of week included in the calendar year 1941. Preliminary production for week of January 3, 1942, was 728,000 tons. Revised total for week of January 4, 1941, was 843,000 tons.

TABLE 10.—*Estimated monthly production of Pennsylvania anthracite, 1934–41, in thousands of net tons* [1]

Month	1934	1935	1936	1937	1938	1939	1940	1941 [2]
January	6,102	5,790	5,315	4,236	4,978	5,019	5,783	5,162
February	5,930	4,652	6,952	3,671	3,646	4,169	3,648	4,596
March	6,394	3,228	3,051	4,795	4,257	3,652	3,881	4,765
April	4,819	4,763	4,757	6,779	3,149	5,367	3,853	3,317
May	5,230	5,118	5,104	4,361	4,400	5,141	4,070	4,001
June	4,168	5,724	4,292	4,635	4,450	3,577	4,492	5,072
July	3,430	3,502	3,912	2,748	2,580	2,951	4,534	4,855
August	3,570	3,073	3,492	2,903	2,735	3,883	3,883	5,441
September	3,962	4,113	3,861	3,682	3,388	4,840	4,172	5,334
October	4,711	4,132	4,593	4,848	4,180	4,985	4,355	5,580
November	4,165	3,432	4,320	4,439	3,803	3,989	3,980	3,974
December	4,687	4,632	4,931	4,759	4,533	3,914	4,834	4,271
	57,168	52,159	54,580	51,856	46,099	51,487	51,485	56,368

[1] Production is estimated from weekly carloadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal. Monthly statistics from 1905 to 1925 will be found in Mineral Resources, 1925, pt. II, pp. 427–428, and from 1926 to 1930 in Mineral Resources, 1930, pt. II, p. 741.

[2] Includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

Small mines and intercompany sales.—All known legitimate operations are included in the statistics. In recent years conditions have favored the development of numerous small mines operating on lease or subcontract and producing run-of-mine coal, which is sold to larger companies for preparation at a breaker. At the same time, an increasing transfer of coal from one operation to another has developed, and some of the companies have built central breakers to which coal from numerous mines is shipped, by rail or truck, for preparation. These tendencies have increased the complexity of the task of collecting and compiling statistics of the industry; but great care has been exercised to avoid double counting of tonnages produced by one operator and prepared for market by another, and the figures herein represent the net quantity of merchantable coal plus the fuel used by the collieries themselves. The employees of legitimate operators producing run-of-mine only have been included in the employment statistics, as they have received wages from the industry and have contributed to the final product.

Regions, fields, and counties.—The anthracite fields are divided into three trade regions—Lehigh, Schuylkill, and Wyoming. This classification is generally used by the trade, and it is also followed in the district organization of the United Mine Workers of America, in which District 1 corresponds to the Wyoming region, District 7 to the Lehigh region, and District 9 to the Schuylkill region. Geographically the anthracite area is classified by fields—the Northern, Eastern Middle, Western Middle, and Southern. This classification is used in technical operating studies because it follows more closely the geologic conditions that largely influence the methods and cost of mining. The Northern field is the same as the Wyoming region. The Lehigh field and that part of the Southern field lying east of Tamaqua (known as the Panther Creek Valley) make up the Lehigh region. The Schuylkill region comprises the Western Middle field and that part of the Southern field lying west of Tamaqua. For historical comparison, the tonnage of the small Bernice Basin is often included with the statistics of the Northern field, although the coal is classified officially as semianthracite. The total area of the four fields is about 484 square miles—the Northern covers 176 square miles, the Eastern Middle 33, the Western Middle 94, and the Southern 181.

Based upon the quantity of minable reserves, the Southern field is first, followed by the Western Middle, Northern, and Eastern Middle.

Tables 11 to 13 present production data by regions, fields, and counties.

Culm-bank coal.—In the early days of anthracite mining, the smaller sizes of anthracite—especially Pea and smaller—were not used, as they are today, and these sizes and larger pieces of refuse containing much good coal were piled in large banks throughout the region. In 1879 the recovery of the sizes smaller than Pea coal was less than 1 percent of all sizes made, but in 1940 these sizes comprised 34 percent of the total breaker shipments. In recent years, with the increased demand for the smaller sizes and the use of modern and efficient preparation methods, material from the culm banks is run through washeries or breakers, and a clean, prepared coal is obtained. This source supplied 2,783,038 tons in 1940 and 3,656,866 tons in 1941. Tables 14 and 15 give a detailed break-down of culm-bank production, by regions and fields.

TABLE 11.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1941, by regions*

Region	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Lehigh:								
Breakers	7,606,556	$34,227,000	391,689	$1,987,000	397,118	$823,000	8,395,363	$37,037,000
Washeries	207,121	662,000	14,133	50,000	2,000	5,000	223,254	717,000
Dredges	35,408	42,000	12,430	15,000			47,838	57,000
Total Lehigh	7,849,085	34,931,000	418,252	2,052,000	399,118	828,000	8,666,455	37,811,000
Schuylkill:								
Breakers	14,567,737	62,088,000	778,616	3,055,000	301,809	519,000	15,648,162	65,662,000
Washeries	1,988,632	4,157,000	46,148	105,000	22,840	47,000	2,057,620	4,309,000
Dredges	967,630	1,137,000	493,700	637,000	2,450	3,000	1,463,780	1,777,000
Total Schuylkill	17,523,999	67,382,000	1,318,464	3,797,000	327,099	569,000	19,169,562	71,748,000
Wyoming:								
Breakers	24,671,656	118,807,000	1,930,706	8,896,000	1,495,471	1,843,000	28,097,833	129,546,000
Washeries	342,939	1,016,000	10,347	30,000	38,166	36,000	391,452	1,082,000
Dredges	5,945	5,000					5,945	5,000
Total Wyoming	25,020,540	119,828,000	1,941,053	8,926,000	1,533,637	1,879,000	28,495,230	130,633,000
Total, excluding Sullivan County:								
Breakers	46,845,949	215,122,000	3,101,011	13,938,000	2,194,398	3,185,000	52,141,358	232,245,000
Washeries	2,538,692	5,835,000	70,628	185,000	63,006	88,000	2,672,326	6,108,000
Dredges	1,008,983	1,184,000	506,130	652,000	2,450	3,000	1,517,563	1,839,000
Total	50,393,624	222,141,000	3,677,769	14,775,000	2,259,854	3,276,000	56,331,247	240,192,000
Sullivan County: [2] Breakers	18,473	32,000	17,356	50,000	1,191	1,000	37,020	83,000
Grand total: 1941	50,412,097	222,173,000	3,695,125	14,825,000	2,261,045	3,277,000	56,368,267	240,275,000
1940	46,175,953	191,332,000	3,052,626	11,314,000	2,256,061	2,844,000	51,484,640	205,490,000
Change, 1941 ... percent	+9.2	+16.1	+21.0	+31.0	+0.2	+15.2	+9.5	+16.9

[1] Value given is value at which coal left possession of producing company, does not include margins of separately incorporated sales companies.
[2] For purposes of historical comparison and statistical convenience, the mines of Sullivan County are grouped with the Pennsylvania anthracite region, although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.

TABLE 12.—*Pennsylvania anthracite produced, 1937–41, by fields, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 1,705,977 tons in 1941. Data for 1913–25 will be found in Mineral Resources, 1925, pt. II, p. 517, and for 1919–30 in Mineral Resources 1930, pt. II, p. 747]

Field	1937	1938	1939	1940	1941
Eastern Middle:					
Breakers	6, 045, 813	5, 217, 169	[1] 5, 444, 335	[1] 5, 104, 708	5, 066, 892
Washeries			(1)	(1)	217, 642
Dredges					5, 032
Total Eastern Middle	6, 045, 813	5, 217, 169	5, 444. 335	5, 104, 708	5, 289, 566
Western Middle:					
Breakers	10, 381, 521	8, 877, 485	9, 242, 223	10, 168, 142	11, 531, 105
Washeries	1, 456, 505	940, 938	906, 992	734, 541	946, 794
Dredges	264, 588	223, 961	253, 819	447, 760	531, 129
Total Western Middle	12, 102, 614	10, 042, 384	10, 403, 034	11, 350, 443	13, 009, 028
Southern:					
Breakers	5, 849, 381	5, 447, 804	6, 196, 051	6, 615, 347	7, 445, 528
Washeries	218, 541	625, 335	855, 659	812, 162	1, 116, 438
Dredges	468, 386	317, 572	432, 974	492, 684	975, 457
Total Southern	6, 536, 308	6, 390, 711	7, 484, 684	7, 920, 193	9, 537, 423
Northern:					
Breakers	26, 707, 743	24, 059, 598	27, 806, 467	26, 571, 383	28, 097, 833
Washeries	347, 959	310, 491	295, 103	484, 569	391, 452
Dredges	27, 500	29, 491	17, 067	2, 500	5, 945
Total Northern	27, 083, 202	24, 399, 580	28, 118, 637	27, 058, 452	28, 495, 230
Total, excluding Sullivan County.					
Breakers	48, 984, 458	43, 602, 056	[1] 48, 689, 076	[1] 48, 459, 580	52, 141, 358
Washeries	2, 023, 005	1, 876, 764	[1] 2, 057, 754	[1] 2, 031, 272	2, 672, 326
Dredges	760, 474	571, 024	703, 860	942, 944	1, 517, 563
Total	51, 767, 937	46, 049, 844	51, 450, 690	51, 433, 796	56, 331, 247
Sullivan County: Breakers	88, 496	49, 183	36, 687	50, 844	37, 020
Grand total	51, 856, 433	46, 099, 027	51, 487, 377	51, 484, 640	56, 368, 267

[1] Small amount of washery coal included with breaker.

TABLE 13.—*Pennsylvania anthracite produced in 1941, by counties*

County	Total shipments		Sold to local trade		Used for power		Total production	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Carbon	2, 481, 852	$10, 705, 000	189, 710	$950, 000	103, 045	$192, 000	2, 774, 607	$11, 847, 000
Columbia	247, 872	1, 123, 000	30, 088	53, 000	7, 158	21, 000	285, 118	1, 197, 000
Dauphin and Lebanon	459, 893	1, 912, 000	294, 670	496, 000	5, 206	8, 000	759, 769	2, 416, 000
Lackawanna	7, 351, 141	34, 379, 000	712, 332	3, 386, 000	467, 774	638, 000	8, 531, 247	38, 403, 000
Luzerne	21, 122, 739	101, 620, 000	1, 402, 704	6, 430, 000	1, 309, 396	1, 766, 000	23, 834, 839	109, 816, 000
Northumberland	5, 337, 886	21, 275, 000	254 806	561. 000	76, 882	129, 000	5. 669, 574	21, 965, 000
Schuylkill	13, 207, 645	50, 564 000	577 728	2, 600, 000	275, 045	505, 000	14, 060, 418	53, 669, 000
Sullivan	18, 473	32, 000	17, 356	50, 000	1, 191	1, 000	37, 020	83, 000
Snyder, Susquehanna, and Wayne	115, 920	482, 000	20, 901	47, 000	15, 348	16, 000	152, 169	545, 000
Berks, Lancaster, Northampton, and York [2]	68, 676	81, 000	194, 830	253, 000			263, 506	334, 000
Total	50, 412, 097	222, 173, 000	3, 695, 125	14, 826, 000	2, 261, 045	3, 276, 000	56, 368, 267	240, 275, 000

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

Reconciliation of fresh-mined, culm-bank, and breaker product.—Anthracite is now produced from three sources—mines (including strip pits), culm banks, and the rivers and creeks that drain the

anthracite region. As all three sources contribute to the country's supply, it is necessary to consider them all to ascertain the total production. No difficulty is experienced in separating the figures of production by dredges, as this is a distinct industry. It is difficult, however, to make a sharp differentiation between fresh-mined and culm-bank coal that can be maintained throughout the statistics of the industry.

TABLE 14.—*Pennsylvania anthracite produced in 1941, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by regions, in net tons*

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Lehigh:						
Breakers	756,562	5,551,949	1,983,351	103,501		8,395,363
Washeries				223,254		223,254
Dredges					47,838	47,838
Total Lehigh	756,562	5,551,949	1,983,351	326,755	47,838	8,666,455
Schuylkill:						
Breakers	1,784,098	9,102,039	3,902,363	859,662		15,648,162
Washeries			36,233	2,021,387		2,057,620
Dredges					1,463,780	1,463,780
Total Schuylkill	1,784,098	9,102,039	3,938,596	2,881,049	1,463,780	19,169,562
Wyoming:						
Breakers	10,901,327	15,744,269	1,339,423	112,814		28,097,833
Washeries			55,204	336,248		391,452
Dredges					5,945	5,945
Total Wyoming	10,901,327	15,744,269	1,394,627	449,062	5,945	28,495,230
Total, excluding Sullivan County:						
Breakers	13,441,987	30,398,257	7,225,137	1,075,977		52,141,358
Washeries			91,437	2,580,889		2,672,326
Dredges					1,517,563	1,517,563
Total	13,441,987	30,398,257	7,316,574	3,656,866	1,517,563	56,331,247
Sullivan County. Breakers		37,020				37,020
Grand total	13,441,987	30,435,277	7,316,574	3,656,866	1,517,563	56,368,267

As the best solution of this problem, the individual breaker, washery, or dredging operation is taken as the unit in compiling the statistics, and the producing companies are asked to supply separate statements for each type of plant. These are totaled to form the primary tables of this report to show the total quantity of breaker product, washery product, and dredge product, with related figures of value and number of employees.

The figures from breaker and washery plants, however, are not exactly equivalent to the fresh-mined and culm-bank coal because of the practice, sometimes adopted, of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery. The tonnage of culm-bank coal prepared at the breakers is broken down by fields and shown in table 16.

Interregional variation in sizes.—Geologic conditions affect the percentages of domestic and steam sizes produced and consequently the value of the product as a whole. In the Wyoming and Lehigh regions,

the percentage yield of the higher-priced domestic sizes is relatively high; in the Schuylkill region, it is less because of the crushing of the coal by faulting and folding of the beds. In 1941, the breaker output of the Wyoming region comprised 70.2 percent domestic sizes and 29.8 percent steam sizes; the Lehigh region—62.8 percent domestic and 37.2 percent steam sizes; the Schuylkill region—57.7 percent domestic and 42.3 percent steam sizes. Table 17 shows shipments of anthracite by regions and sizes. Table 18 shows by regions the percentages of various sizes in relation to total breaker product.

TABLE 15.—*Pennsylvania anthracite produced in 1941, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by fields, in net tons*

Field and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Eastern Middle						
Breakers	756, 562	3, 182, 504	1, 070, 385	57, 441		5, 066, 892
Washeries				217, 642		217, 642
Dredges					5, 032	5, 032
Total Eastern Middle	756, 562	3, 182, 504	1, 070, 385	275, 083	5, 032	5, 289, 566
Western Middle						
Breakers	1, 680, 993	6, 823, 859	2, 507, 723	518, 530		11, 531, 105
Washeries			36, 233	910, 561		946, 794
Dredges					531, 129	531, 129
Total Western Middle	1, 680, 993	6, 823, 859	2, 543, 956	1, 429, 091	531, 129	13, 009, 028
Southern						
Breakers	103, 105	4, 647, 625	2, 307, 606	387, 192		7, 455, 528
Washeries				1, 116, 438		1, 116, 438
Dredges					975, 457	975, 457
Total Southern	103, 105	4, 647, 625	2, 307, 606	1, 503, 630	975, 457	9, 537, 423
Northern:						
Breakers	10, 901, 327	15, 744, 269	1, 339, 423	112, 814		28, 097, 833
Washeries			55, 204	336, 248		391, 452
Dredges					5, 945	5, 945
Total Northern	10, 901, 327	15, 744, 269	1, 394, 627	449, 062	5, 945	28, 495, 230
Total, excluding Sullivan County						
Breakers	13, 441, 987	30, 398, 257	7, 225, 137	1, 075, 977		52, 141, 358
Washeries			91, 437	2, 580, 889		2, 672, 326
Dredges					1, 517, 563	1, 517, 563
Total	13, 441, 987	30, 398, 257	7, 316, 574	3, 656, 866	1, 517, 563	56, 331, 247
Sullivan County Breakers		37, 020				37, 020
Grand total	13, 441, 987	30, 435, 277	7, 316, 574	3, 656, 866	1, 517, 563	56, 368, 267

TABLE 16.—*Culm-bank coal put through breakers, 1937–41, by fields, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total [1]
1937	95, 000	67, 000	102, 000	606, 000	870, 000
1938	52, 000	11, 000	44, 000	455, 000	562, 000
1939	70, 000	17, 000	204, 000	295, 000	586, 000
1940	13, 000	[2] 139, 000	250, 000	362, 000	764, 000
1941	113, 000	57, 000	519, 000	387, 000	1, 076, 000

[1] No culm-bank coal is put through breakers in Sullivan County.
[2] Includes some washery coal.

TABLE 17.—*Pennsylvania anthracite shipped in 1941, by regions and sizes*

Size	Breaker shipments [1]						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total				
					Excluding Sullivan County	Including Sullivan County			
Net tons									
Lump [2] and Broken	37,591	73,827	39,035		150,453	150,453			150,453
Egg	269,036	520,574	1,153,935		1,943,545	1,943,545			1,943,545
Stove	1,752,863	2,846,927	6,807,603	977	11,407,393	11,408,370	66,338		11,474,708
Chestnut	1,834,243	3,303,451	6,826,353	2,710	11,964,047	11,966,757	212,789		12,179,546
Pea	881,566	1,665,471	2,504,357	2,201	5,051,394	5,053,595	110,802	(3)	5,164,397
Total domestic sizes	4,775,299	8,410,250	17,331,283	5,888	30,516,832	30,522,720	389,929		30,912,649
Buckwheat No. 1	1,168,703	2,369,344	3,298,618	690	6,836,665	6,837,355	467,130	[3] 53,057	7,357,542
Buckwheat No. 2 (Rice)	641,228	1,419,552	1,760,417		3,821,197	3,821,197	450,174	128,963	4,400,334
Buckwheat No. 3 (Barley)	676,411	1,660,730	1,827,157	1,361	4,164,298	4,165,659	602,841	344,099	5,112,599
Buckwheat No. 4	262,562	595,754	278,844	[4] 10,534	1,137,160	1,147,694	596,132	450,593	2,194,419
Other		57,491	1,025		58,516	58,516		32,271	90,787
Silt	82,353	54,616	174,312	(4)	311,281	311,281	32,486		343,767
Total steam sizes	2,831,257	6,157,487	7,340,373	12,585	16,329,117	16,341,702	2,148,763	1,008,983	19,499,448
Grand total	7,606,556	14,567,737	24,671,656	18,473	46,845,949	46,864,422	2,538,692	1,008,983	50,412,097
Value									
Lump [2] and Broken	$211,000	$430,000	$219,000		$860,000	$860,000			$860,000
Egg	1,557,000	3,042,000	6,748,000		11,347,000	11,347,000			11,347,000
Stove	10,383,000	16,898,000	40,378,000	$4,000	67,659,000	67,663,000	$334,000		67,997,000
Chestnut	10,922,000	19,416,000	40,564,000	10,000	70,902,000	70,912,000	1,020,000		71,932,000
Pea	3,990,000	7,415,000	11,311,000	6,000	22,716,000	22,722,000	444,000	(3)	23,166,000
Total domestic	27,063,000	47,201,000	99,220,000	20,000	173,484,000	173,504,000	1,798,000		175,302,000
Buckwheat No. 1	3,928,000	7,918,000	11,205,000	1,000	23,051,000	23,052,000	1,478,000	[3] $162,000	24,692,000
Buckwheat No. 2 (Rice)	1,627,000	3,447,000	4,563,000		9,637,000	9,637,000	990,000	233,000	10,860,000
Buckwheat No. 3 (Barley)	1,244,000	2,775,000	3,387,000	1,000	7,406,000	7,407,000	954,000	392,000	8,753,000
Buckwheat No. 4	309,000	612,000	301,000	10,000	1,222,000	1,232,000	586,000	370,000	2,188,000

See footnotes at end of table

TABLE 17.—*Pennsylvania anthracite shipped in 1941, by regions and sizes*—Continued

Size	Breaker shipments						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total				
					Excluding Sullivan County	Including Sullivan County			
Value—Continued									
Other		$108,000	$3,000		$111,000	$111,000		$27,000	$138,000
Silt	$56,000	27,000	128,000		211,000	211,000	$29,000		240,000
Total steam	7,164,000	14,887,000	19,587,000	$12,000	41,638,000	41,650,000	4,037,000	1,184,000	46,871,000
Grand total	34,227,000	62,088,000	118,807,000	32,000	215,122,000	215,154,000	5,835,000	1,184,000	222,173,000
Average value per ton									
Lump [2] and Broken	$5.61	$5.82	$5.61		$5.72	$5.72			$5.72
Egg	5.79	5.84	5.85		5.84	5.84			5.84
Stove	5.92	5.94	5.93	$4.09	5.93	5.93	$5.03		5.93
Chestnut	5.95	5.88	5.94	3.69	5.93	5.93	4.79		5.91
Pea	4.53	4.45	4.52	2.73	4.50	4.50	4.01	(3)	4.49
Total domestic	5.67	5.61	5.72	3.40	5.68	5.68	4.61		5.67
Buckwheat No. 1	3.36	3.34	3.40	1.45	3.37	3.37	3.16	[3] $3.05	3.38
Buckwheat No. 2 (Rice)	2.54	2.43	2.59		2.52	2.52	2.20	1.81	2.47
Buckwheat No. 3 (Barley)	1.84	1.67	1.85	.73	1.78	1.78	1.58	1.14	1.71
Buckwheat No. 4	1.18	1.03	1.08	.95	1.07	1.07	.98	.82	1.00
Other		1.88	2.93		1.90	1.90		.84	1.52
Silt	.68	.49	.73		.68	.68	.89		.70
Total steam	2.53	2.42	2.67	.95	2.55	2.55	1.88	1.17	2.40
Grand total	4.50	4.26	4.82	1.73	4.59	4.59	2.30	1.17	4.41

[1] Includes some culm-bank coal handled in the breakers.
[2] Quantity of Lump included is insignificant.
[3] Small amount of Pea included in Buckwheat No. 1.
[4] Some Silt included in Buckwheat No. 4.

TABLE 18.—*Sizes of Pennsylvania anthracite shipped from breakers, 1939–41, by regions, in percent of total*

[Note that shipments of dredge and washery coal are not included]

Size	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1939	1940	1941	1939	1940	1941	1939	1940	1941
Lump [1] and Broken	0.5	0.5	0.5	0.4	0.4	0.5	0.7	0.2	0.1
Egg	4.0	3.8	3.5	3.9	3.9	3.6	6.2	5.0	4.7
Stove	23.1	23.3	23.1	19.0	19.1	19.5	26.8	27.0	27.6
Chestnut	24.9	24.7	24.1	23.9	23.3	22.7	27.1	27.6	27.7
Pea	11.8	11.5	11.6	11.6	11.8	11.4	10.5	10.6	10.1
Total domestic	64.3	63.8	62.8	58.8	58.5	57.7	71.3	70.4	70.2
Buckwheat No. 1	15.5	15.6	15.4	15.8	16.2	16.3	13.2	13.6	13.4
Buckwheat No. 2 (Rice)	8.3	8.3	8.4	8.9	9.3	9.7	7.1	6.9	7.2
Buckwheat No. 3 (Barley)	8.4	8.4	8.9	11.7	11.4	11.4	7.0	7.6	7.4
Other, including Buckwheat No. 4	3.5	3.9	3.4	4.8	4.6	4.5	1.4	1.5	1.1
Silt	-----	-----	1.1	-----	-----	.4	-----	-----	.7
Total steam [2]	35.7	36.2	37.2	41.2	41.5	42.3	28.7	29.6	29.8

Size	Sullivan County			Total—					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	-----	-----	-----	0.6	0.3	0.3	0.6	0.3	0.3
Egg	-----	-----	-----	5.2	4.5	4.1	5.2	4.5	4.2
Stove	14.1	13.8	5.3	24.1	24.1	24.4	24.1	24.1	24.3
Chestnut	19.3	18.7	14.7	25.8	25.9	25.5	25.8	25.9	25.5
Pea	13.5	12.6	11.9	11.0	11.1	10.8	11.0	11.1	10.8
Total domestic	46.9	45.1	31.9	66.7	65.9	65.1	66.7	65.9	65.1
Buckwheat No. 1	9.1	9.7	3.7	14.3	14.7	14.6	14.3	14.7	14.6
Buckwheat No. 2 (Rice)	14.8	15.8	-----	7.8	7.8	8.2	7.8	7.8	8.2
Buckwheat No. 3 (Barley)	-----	-----	7.4	8.5	8.8	8.9	8.5	8.8	8.9
Other, including Buckwheat No. 4	29.2	29.4	[3] 57.0	2.7	2.8	2.5	2.7	2.8	2.5
Silt	-----	-----	(3)	-----	-----	.7	-----	-----	.7
Total steam [2]	53.1	54.9	68.1	33.3	34.1	34.9	33.3	34.1	34.9

[1] Quantity of Lump included is insignificant.
[2] Includes all steam sizes.
[3] Some Silt included in Buckwheat No. 4.

AVERAGE SALES REALIZATION

The valuation figures in this study represent value at the breaker or washery reported by the operating companies. The company is requested to "estimate value of the product not sold" and to "exclude selling expenses" in making its report.

From this it will be seen that when a producing concern sells its output to a separately organized sales company, the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal is placed on the general market. This fact should be borne in mind in considering the variations in value among different regions, shown in the tables, for the same sizes of coal.

The average sales realization per net ton on breaker shipments was $4.59 in 1941 compared with $4.27 in 1940 (see table 19). If local sales, colliery fuel, and washery and dredge coal are included, the average value per net ton of the total 1941 production was $4.26 compared with $3.99 in 1940 (see table 20).

TABLE 19.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1939–41, by regions and sizes*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1939	1940	1941	1939	1940	1941	1939	1940	1941
Lump [1] and Broken	$4.92	$5.31	$5.61	$5.26	$5.82	$5.82	$4 38	$5.21	$5.61
Egg	4.73	5.27	5.79	4.95	5.38	5 84	4.67	5.30	5.85
Stove	4.87	5.45	5.92	4.98	5.50	5.94	4.79	5 46	5.93
Chestnut	4.95	5.51	5.95	4 98	5.46	5.88	4.79	5.50	5.94
Pea	3.73	4 15	4 53	3.69	4.09	4.45	3 60	4.15	4.52
Total domestic	4.69	5.23	5.67	4 73	5.19	5 61	4.60	5.27	5.72
Buckwheat No. 1	2.93	3.16	3 36	2 84	3 16	3 34	2 92	3.19	3.40
Buckwheat No. 2 (Rice)	2 17	2 32	2 54	2.21	2 31	2.43	2 21	2.39	2.59
Buckwheat No. 3 (Barley)	1.65	1.70	1 84	1.51	1.59	1.67	1.70	1.75	1.85
Total steam [2]	2.25	2.37	2.53	2 10	2.29	2.42	2 35	2.52	2.67
Total all sizes	3.81	4.18	4.50	3.64	3.99	4.26	3.95	4.45	4.82

Size	Sullivan County			Total—Excluding Sullivan County			Total—Including Sullivan County		
	1939	1940	1941	1939	1940	1941	1939	1940	1941
Lump [1] and Broken				$4 63	$5 49	$5.72	$4 63	$5.49	$5.72
Egg				4.73	5 32	5 84	4.73	5 32	5.84
Stove	$4.03	$4 31	$4 09	4 84	5.47	5 93	4.84	5.47	5.93
Chestnut	4 40	4 29	3 69	4 87	5 49	5 93	4 87	5 49	5.93
Pea	3.15	3 32	2 73	3 65	4.13	4.50	3 65	4.13	4.50
Total domestic	3 93	4 02	3 40	4 64	5 24	5.68	4 64	5 24	5.68
Buckwheat No. 1	3 13	2 51	1.45	2 90	3.18	3 37	2 90	3 18	3 37
Buckwheat No. 2 (Rice)	.96	1.10		2.20	2 35	2 52	2 20	2.35	2.52
Buckwheat No. 3 (Barley)			.73	1 62	1 68	1 78	1 62	1.68	1.78
Total steam [2]	1 07	1 08	.95	2 25	2 41	2.55	2 25	2.41	2.55
Total all sizes	2.41	2.41	1.73	3.85	4.27	4.59	3.85	4.27	4.59

[1] Quantity of Lump included is insignificant.
[2] Includes all steam sizes.

TABLE 20.—*Average value per net ton of Pennsylvania anthracite shipments, local sales, colliery fuel, and total production, 1940–41, by regions* [1]

[Note that values in this table include washery and dredge coal]

Region	1940				1941			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$4 16	$4.76	$1.83	$4 08	$4.45	$4.91	$2.07	$4.36
Schuylkill	3.67	2 29	1.53	3.55	3.85	2 88	1.74	3.74
Wyoming	4.43	4.25	1 06	4.23	4.79	4 60	1.23	4.58
Total, excluding Sullivan County	4 14	3.71	1.26	3 99	4.41	4 02	1.45	4.26
Sullivan County	2 41	2 51	1 10	2.40	1.73	2 88	.84	2 24
Grand total	4.14	3.71	1.26	3 99	4.41	4.01	1 45	4.26

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

LABOR STATISTICS

The peak year for employment in the Pennsylvania anthracite industry was 1914, when 179,679 men were employed; in 1917, the year of largest output, the number was 154,174. The average number of men employed in 1941 was 88,054, a decrease of 3,259 from the 91,313 employed in 1940 (see tables 21 and 22). The number employed is based upon reports by the operators and includes the workers from strip-pit and dredge operations.

These statistics do not consider the men and boys working in "bootleg" or illicit coal mining, which has increased in output considerably since its start in the early 1930's. Before 1941, production statistics of the Bureau did not include "bootleg" coal; however, in 1941 many legitimate operators purchased run-of-mine coal from the "bootleggers," prepared it at their breakers for shipment to market, and, in their annual reports to the Bureau, included this purchased coal with the legitimate output. It would be very difficult to obtain employment data for the holes from which this "bootleg" coal was dug. Therefore, in calculating the output per man per day, the tons of "bootleg" purchased were deducted from the total output as reported by the operators, and the resulting legitimate production was then used to calculate the output per man per day. Part of the time of the preparation men in legitimate plants was, of course, required for preparing the illicit product; however, on a per-ton basis this time is very small, and its omission will not detract materially from the validity of the result obtained.

Although there were no major labor disturbances in 1941, several thousand miners in the Schuylkill and Lehigh regions were away from work for about a month because of some dissatisfaction concerning union dues and assessments. The number of man-days lost because of strikes totaled 176,432 and 397,616 in 1940 and 1941, respectively, and the average days lost per man employed in the industry was 1.9 and 4.5 in these respective years (see table 23).

According to the Bureau of Labor Statistics, average weekly earnings in 1941 ranged from a low of $16.43 in April to a high of $34.20 in June and were $27.41 for the year as a whole compared with $24.95 in 1940. The index of employment (1929 average=100) fluctuated between 48.6 percent in May and 50.6 percent in February and for the year as a whole averaged 2 percent below 1940. The index of pay rolls (1929 average=100) reached a low of 24.3 in April and a high of 51.2 in June and averaged 7.5 percent above 1940.

TABLE 21.—*Men employed and days worked at operations producing Pennsylvania anthracite in 1941, by regions* [1]

[Includes operations of strip contractors]

Region	Average number of men employed								Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface				Grand total			
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other	Total surface				
Lehigh:											
Breaker	5,958	4,204	10,162	1,566	1,105	2,464	5,135	15,297	193	2,948,832	[2] 2.83
Washery					39	98	137	137	166	22,800	[3] 9.79
Dredge					8	20	28	28	142	3,982	12.01
Total Lehigh	5,958	4,204	10,162	1,566	1,152	2,582	5,300	15,462	192	2,975,614	[2] 2.90
Schuylkill:											
Breaker	8,484	4,932	13,416	2,355	1,768	2,977	7,100	20,516	211	4,320,174	[2] 3.19
Washery					123	716	839	839	172	144,153	[3] 14.27
Dredge					140	320	460	460	221	101,827	14.38
Total Schuylkill	8,484	4,932	13,416	2,355	2,031	4,013	8,399	21,815	209	4,566,154	[2] 3.79
Wyoming:											
Breaker	27,596	13,950	41,546	674	2,488	5,776	8,938	50,484	204	10,323,894	2.72
Washery				14	94	82	190	190	165	31,342	[3] 12.49
Dredge					8	6	14	14	74	1,036	5.74
Total Wyoming	27,596	13,950	41,546	688	2,590	5,864	9,142	50,688	204	10,356,272	2.75
Total, excluding Sullivan County.											
Breaker	42,038	23,086	65,124	4,595	5,361	11,217	21,173	86,297	204	17,592,900	[2] 2.86
Washery				14	256	896	1,166	1,166	170	198,295	[3] 13.48
Dredge					156	346	502	502	213	106,845	14.20
Total	42,038	23,086	65,124	4,609	5,773	12,459	22,841	87,965	203	17,898,040	[2] 3.04
Sullivan County: Breaker	46	14	60		10	19	29	89	225	20,020	1.85
Grand total	42,084	23,100	65,184	4,609	5,783	12,478	22,870	88,054	203	17,918,060	[2] 3.04

[1] Men employed in "bootleg" operations excluded.
[2] Output per man per day calculated on legitimate tonnages only; "bootleg" purchases excluded.
[3] Represents washeries for which both production and employment were separately reported.

TABLE 22.—*Men employed at operations producing Pennsylvania anthracite, 1940–41, by counties*

[Includes operations of strip contractors]

County	Men 1940	Men 1941	County	Men 1940	Men 1941
Carbon	4,906	5,058	Sullivan	182	89
Columbia	500	444	Snyder, Susquehanna, and Wayne	[1] 302	124
Dauphin and Lebanon	1,045	861	Berks, Lancaster, Northampton, and York [2]	[3] 47	118
Lackawanna	17,381	15,153		91,313	88,054
Luzerne	43,086	42,773			
Northumberland	7,556	6,494			
Schuylkill	16,308	16,940			

[1] None in Snyder County in 1940.
[2] Counties producing dredge coal only.
[3] None in Lancaster County in 1940.

TABLE 23.—*Strikes, suspensions, and lock-outs in Pennsylvania anthracite region in 1941*

	Lehigh	Schuylkill	Wyoming	Total, excluding Sullivan County	Sullivan County	Grand total
Total men employed	15,462	21,815	50,688	87,965	89	88,054
Men on strike	12,383	10,955	16,430	39,768		39,768
Man-days lost on account of strike	237,701	46,268	113,647	397,616		397,616
Average days lost—						
Per man employed	15 4	2 1	2.2	4 5		4.5
Per man on strike	19.2	4.2	6.9	10.0		10.0

EQUIPMENT AND METHODS OF MINING

Mechanical loading.—The quantity of coal loaded mechanically underground increased from 12,326,000 net tons in 1940 to 13,442,000 tons in 1941. Hand-loaded tonnage also increased in 1941 over 1940, but upon a percentage basis the gain in mechanically loaded coal was greater than the increase in the hand-loaded anthracite. Details of mechanical loading, hand loading, and stripping are given in tables 24 to 26. Figure 2 illustrates the relative growth of mechanical loading, hand loading, and stripping in the Pennsylvania anthracite region, 1927–41.

TABLE 24.—*Relative grouth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1937–41*

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons: Mechanical loading underground	Net tons: Stripping	Net tons: Hand loading	Index numbers: 1927=100: Mechanical loading underground	Index numbers: 1927=100: Stripping	Index numbers: 1927=100: Hand loading
1937	10,684,000	5,696,000	31,883,000	481	265	45
1938	10,152,000	5,095,000	27,990,000	457	237	39
1939	11,774,000	5,486,000	30,798,000	530	255	43
1940	12,326,000	6,353,000	29,191,000	554	295	41
1941	13,442,000	7,317,000	30,435,000	605	340	43

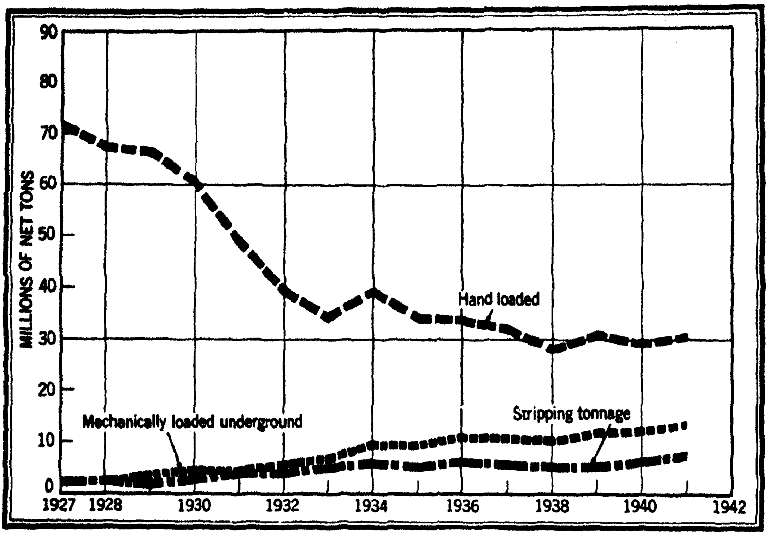

FIGURE 2.—Relative growth of mechanical loading, hand loading, and stripping of Pennsylvania anthracite, 1927–41.

TABLE 25.—*Pennsylvania anthracite loaded mechanically underground, 1937–41*

Year	Scrapers		Conveyors and pit-car loaders [1]		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons handled	Number of units	Net tons handled
1937	539	2,873,289	[2] 1,855	[2] 7,810,548	2,394	10,683,837
1938	545	2,589,954	[2] 1,831	[2] 7,561,715	2,376	10,151,669
1939	535	3,088,956	1,997	8,684,877	2,532	11,773,833
1940	[2] 547	[2] 2,983,792	2,189	9,342,208	2,736	12,326,000
1941	[2] 505	[2] 2,673,983	2,432	10,768,004	2,937	13,441,987

[1] Includes duckbills and other self-loading conveyors, which account for only a small part of the total.
[2] Includes mobile loaders.

TABLE 26.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1941, by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face conveyors, all types [1]	Total mechanically loaded underground
Northern	2,295,015	228,350	8,377,962	10,901,327
Eastern Middle	127,505	47,213	581,844	756,562
Western Middle	248,103	106,795	1,326,095	1,680,993
Southern	3,360	79,745	20,000	103,105
	2,673,983	462,103	10,305,901	13,441,987

[1] Shaker chutes, etc., including those equipped with duckbills.

Cutting machines.—The quantity cut by machines increased from 1,816,483 net tons in 1940 to 1,855,422 in 1941. Details are shown in table 27.

TABLE 27.—*Pennsylvania anthracite cut by machines, 1940–41, by regions*

Region	1940			1941		
	Cutting machines		Net tons cut by machines	Cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh						
Schuylkill						
Wyoming	185	65	1,816,483	161	61	1,855,422
Total, excluding Sullivan County	185	65	1,816,483	161	61	1,855,422
Sullivan County						
Grand total	185	65	1,816,483	161	61	1,855,422

Strip-pit operations.—Strip-pit tonnage increased from 6,353,000 net tons in 1940 to 7,317,000 in 1941. In 1941 more than half of the stripping tonnage was recovered from pits in the Schuylkill region, and the Lehigh and Wyoming regions followed in order of output. For details of anthracite mined from strip pits see table 28. Figure 3 illustrates graphically the production of anthracite from strip pits, by regions, 1927–41.

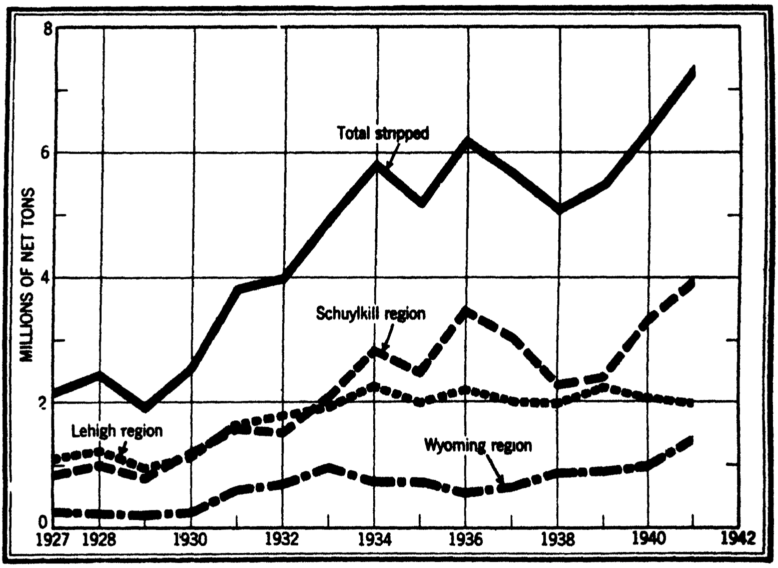

FIGURE 3.—Pennsylvania anthracite mined from strip pits, by regions, 1927–41.

TABLE 28.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1938–41*

Year	Number of power shovels in use [1]	Net tons mined by stripping		Percent of fresh-mined total that was stripped	Number of men employed	Average number of days worked
		Total	Average per shovel			
1915	57	1,121,603	19,677	(2)	(2)	(2)
1920	96	2,054,441	21,400	2.5	(2)	(2)
1925	97	1,578,478	16,273	2.7	(2)	(2)
1930	108	2,526,288	23,484	3.7	(2)	(2)
1938	331	5,095,341	15,394	11.8	3,642	186
1939	346	5,486,479	15,857	11.4	3,924	156
1940	348	6,352,700	18,255	13.3	4,114	190
1941:						
Lehigh region	(2)	1,983,351	(2)	23.9	1,566	192
Schuylkill region	(2)	3,938,596	(2)	26.6	2,355	190
Wyoming region	(2)	1,394,627	(2)	5.0	688	188
Total, 1941	(2)	7,316,574	(2)	14.3	4,609	191

[1] Certain equipment reported by stripping contractors may have been counted twice when moved from one small job to another during the year. The amount of such double counting is unknown but presumably is not great.
[2] Data not available.

"RIVER" OR "DREDGE" COAL [2]

Review of the river-coal industry.—The rivers and creeks that traverse the anthracite fields of Pennsylvania have been dredged for "river" or "dredge" coal since about 1890. The principal rivers draining the fields, where dredging is being carried on, are the Susquehanna, Schuylkill, and Lehigh. Several creeks—the Shamokin, Mahanoy, Wiconisco, and Swatara—also are productive sources of river or creek coal. Operations along the streams cover a wide territory, and along the Susquehanna alone dredges are recovering coal for about 160 miles.

Early in the history of the Pennsylvania anthracite industry the small sizes of coal were not used as extensively as they are today. Grate, Egg, Stove, and Chestnut were the principal sizes shipped to market and used by the local trade. Pea and smaller sizes were not considered to have any great value and generally were discarded on culm banks with other refuse from cleaning, or they were washed into the rivers and creeks coursing through the anthracite fields. In recent years, with modern preparation methods and increasing demand for small sizes, the anthracite industry has recovered virtually all coal larger than Barley ($\frac{3}{16}$ by $\frac{3}{32}$ inch) and a substantial percentage of the still smaller sizes. Consequently, not nearly as much coal is deposited in the streams today as in the early days of the industry.

As stated, river coal was first dredged in the 1890's, but the earliest production reports received by the Geological Survey were for 1909. From 1909 to 1940, inclusive, dredge operators reported—to the Geological Survey and subsequently to the Bureau of Mines—the recovery of 17,624,533 net tons. Although this is only a small fraction of the total output of anthracite, it is important from the standpoint of conservation of natural resources. In 1940 this source supplied 942,944 tons of anthracite valued at $1,097,000.

[2] For detailed information on "river" or "dredge" coal, reader is referred to Corgan, Joseph A., Dredging Pennsylvania Anthracite: Bureau of Mines Inf. Circ. 7213, 1942, 25 pp.

Early river-coal operations.—The first commercial operations to recover river anthracite were begun in the Susquehanna River in the 1890's, when sand and gravel producers working the Susquehanna recovered coal as a byproduct.[3] It is quite likely that private individuals living along the rivers and creeks recovered by hand some of the large sizes, such as Chestnut and Pea, before 1890 for use in their homes. At that time heating and power plants were not equipped, as they are today, to burn the fine coal taken from the streams, and there was little demand for the product. When it became known that the dredged product could be used advantageously, the river coal became more popular, and industries and utilities began using it to generate steam.

Early preparation methods and sizes produced.—To show more clearly how anthracite came into the rivers and creeks, it is well to give a short résumé of the early methods used by the anthracite industry for cleaning and preparing the product for market.

Anthracite was first sold as run-of-mine, but it was not long before the producers realized that the coal was better-received by the public when it was sized and the small coal taken out. With the advent of breakers and shaking screens, the coal was sized more systematically; anything smaller than Stove was not considered marketable and was piled in culm banks outside the mine. These culm banks contained much good coal and over a period of years rainstorms washed part of the banks into the streams, adding to the river coal. The jigging or wet method of cleaning anthracite for market was introduced in the 1870's. The water used in wet cleaning carried large quantities of the smaller coal to creeks and rivers. In time, more efficient ways of using water to clean coal were devised, and there is no resemblance between the quantity of culm discharged in waste water now and that of 50 or even 25 years ago.

Statistics of production before 1890, by sizes, are not available for the entire anthracite region. Tables 29 and 30 reveal that in 1879 less than 1 percent of the coal smaller than Pea size was prepared for market. As shown in tables 29, 30, and 31, recovery of small sizes and a decline in percentage of Lump, Steamer, and Broken coal were underway in 1889.

TABLE 29.—*Sizes of Pennsylvania anthracite made by a producer in the Lehigh region, 1879 and 1889, in percent of total*

Size	1879	1889	Size	1879	1889
Lump and Steamer	15.8	8 91	Chestnut	17 4	15.58
Broken	19 4	16 69	Pea	15.2	14.27
Egg	15.9	13 13	Buckwheat and small coals	.5	18.07
Stove	15.8	13 35	Total for the producer	100.0	100 00

Table 32 gives statistics of sizes for the anthracite region in selected years. The definite trend from larger to smaller sizes is evident. Lump and Broken coal, which in 1890 constituted 25 percent of total shipments, were negligible in 1940, representing only 0.3 percent of the total product, whereas Buckwheat No. 1 and smaller, comprising

[3] Sisler, James D., Fraser, Thomas, and Ashmead, Dever C., Anthracite, Culm, and Silt: Pennsylvania Geol. Survey, 4th ser., Bull. M-12, 1928, p. 168.

10 percent of the shipments in 1890, amounted to 36 percent of the shipments in 1940. It is apparent from these tables that sizes considered unmarketable years ago are now treated as valuable and comprise a large percentage of the anthracite shipped.

TABLE 30.—*Sizes of Pennsylvania anthracite made by a producer in the Wyoming region, 1879 and 1889, in percent of total*

Size	1879	1889	Size	1879	1889
Lump and Steamer	11.13	11.00	Chestnut	20.32	21.00
Broken	16 11	11.00	Pea	7.47	9.00
Egg	14.06	15.00	Buckwheat and small coals	.27	8.00
Stove	30.64	25.00	Total for the producer	100 00	100.00

TABLE 31.—*Sizes of Pennsylvania anthracite produced in the Schuylkill region, 1883 and 1889, in percent of total*

Size	1883	1889	Size	1883	1889
Lump and Steamer	14 3	9.4	Chestnut	11.6	12.8
Broken	14 7	14 5	Pea	14 8	18.3
Egg	15 5	13.6	Buckwheat	5 0	8.2
Stove	19 0	14 8			
Small stove	5 1	8.4	Total for Schuylkill region	100.0	100.0

TABLE 32.—*Shipments of Pennsylvania anthracite, 1890, 1901, 1910, 1920, 1930, and 1940, by sizes*

[Excludes Sullivan County and dredge production; includes washery product]

Size	1890		1901		1910	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Lump	4,825,276	11 8	2,450,059	4 1	809,499	1.1
Broken	5,216,032	12 7	4,954,414	8 3	3,745,904	5.1
Egg	5,246,274	12 8	7,828,050	13.1	8,844,518	12.1
Stove	9,345,896	22.8	11,829,392	19 7	13,404,003	18 4
Chestnut	6,899,761	16 8	11,480,616	19 1	15,964,918	21.9
Pea	5,268,246	12 8	8,462,662	14 1	8,716,780	11.9
Buckwheat No. 1	3,303,543	8 1	8,841,966	14.7	10,600,271	14.5
Smaller than Buckwheat No. 1	904,286	2.2	4,149,674	6 9	10,931,244	15.0
	41,009,314	100.0	59,996,833	100.0	73,017,137	100.0

Size	1920		1930		1940	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Lump	37,323	0 1	290,843	0.5	127,966	0.3
Broken	3,676,531	4 8			1,963,954	4.3
Egg	11,092,039	14.6	6,305,322	10.4	10,533,860	23.1
Stove	13,800,437	18.2	15,418,753	25.4	11,490,689	25.2
Chestnut	19,310,694	25.4	15,463,954	25.4	4,947,184	10.9
Pea	6,051,116	8.0	4,992,326	8 2	6,727,098	14.8
Buckwheat No. 1	10,254,003	13.5	8,566,726	14.1		
Smaller than Buckwheat No 1	11,706,173	15.4	9,752,646	16 0	9,742,639	21.4
	75,928,316	100.0	60,790,570	100.0	45,533,390	100.0

Production.—River-coal statistics were published first by the Geological Survey in 1909, when the output reported by dredge-coal operators was 107,788 net tons. In 1940 production as reported to the Bureau of Mines was 942,944 tons, with an indicated value of $1,097,000. The total output reported from 1909 to 1940 to the Geological Survey and subsequently to the Bureau of Mines was 17,624,533 net tons. Statistics for some of the early years may not have been complete, because many of the dredge operations were small and the operators could not be reached easily by correspondence.

As shown in table 33, the first year in which statistics were reported by rivers (including tributaries) was 1923, when the total production was 956,368 net tons valued at $811,065. It is to be noted that in 1923, as in every succeeding year to date, the output from the Susquehanna River and its tributaries was far greater than that of the Lehigh or Schuylkill Rivers.

TABLE 33.—*Pennsylvania anthracite produced by dredges, 1909–40, by rivers (including tributaries)*

Year	Net tons				Value	
	Lehigh River	Schuylkill River	Susquehanna River	Total	Total	Average per ton
1909	(1)	(1)	(1)	107,788	(1)	(1)
1910	(1)	(1)	(1)	102,853	(1)	(1)
1911	(1)	(1)	(1)	106,005	(1)	(1)
1912	(1)	(1)	(1)	96,009	(1)	(1)
1913	(1)	(1)	(1)	150,064	(1)	(1)
1914	(1)	(1)	(1)	115,257	(1)	(1)
1915	(1)	(1)	(1)	138,421	$100,744	$0.73
1916	(1)	(1)	(1)	160,507	110,831	.69
1917	(1)	(1)	(1)	170,672	206,754	1.21
1918	(1)	(1)	(1)	282,930	366,565	1.30
1919	(1)	(1)	(1)	693,093	868,746	1.25
1920	(1)	(1)	(1)	740,453	862,296	1.16
1921	(1)	(1)	(1)	623,329	650,654	1.04
1922	(1)	(1)	(1)	904,108	989,709	1.09
Total 1909–22 [2]	(1)	(1)	(1)	4,391,489	[2] 4,156,299	[2] 1.12
1923	106,092	97,254	753,022	956,368	811,065	.85
1924	80,301	74,359	670,734	825,394	681,181	.83
1925	99,614	173,639	742,455	1,015,708	929,292	.91
1926	58,544	131,654	724,566	914,764	828,398	.91
1927	85,177	127,705	758,935	971,817	794,807	.82
1928	89,304	157,449	696,648	943,401	821,530	.87
1929	87,241	133,720	495,983	716,944	626,187	.87
1930	60,219	138,236	444,836	643,291	538,268	.84
1931	33,014	90,855	334,881	458,750	379,682	.83
1932	42,091	105,990	331,969	480,050	445,799	.93
1933	51,083	106,004	381,837	538,924	452,153	.84
1934	91,346	100,873	459,961	652,180	636,038	.98
1935	78,578	73,326	438,563	590,467	517,304	.88
1936	63,327	31,669	451,688	546,684	581,679	1.06
1937	[3] 95,065	(3)	665,409	760,474	842,052	1.11
1938	[3] 123,452	(3)	447,572	571,024	570,579	1.00
1939	62,134	67,539	574,187	703,860	746,000	1.06
1940	[3] 78,947	(3)	863,997	942,944	1,097,000	1.16
Total 1923–40	[3] 1,385,529	[3] 1,610,272	10,237,243	13,233,044	12,299,014	.93
Grand total	(1)	(1)	(1)	17,624,533	(1)	(1)

[1] Data not available.
[2] Figures for value cover 1915–22.
[3] Schuylkill included with Lehigh in 1937, 1938, and 1940.

The average value per ton of the river product reached a high of $1.30 in 1918 and in 1940 was reported to the Bureau of Mines as

$1.16. These values are low compared with the value per ton of all Pennsylvania anthracite, which averaged $3.99 in 1940.

The average output per man per day in river-coal operations is much higher than in the anthracite industry proper; in 1940 it was 12.60 tons compared with 3.02 tons for the entire Pennsylvania anthracite industry.

According to Geological Survey records, of the total shipments of river coal in 1920, Buckwheat No. 3 and larger comprised 59.5 percent, whereas Buckwheat No. 4 and smaller represented 40.5 percent. In 1940 Buckwheat No. 3 and larger decreased to 46.3 percent of the shipped coal, and Buckwheat No. 4 and smaller increased to 53.7 percent.

Quality and uses.—The quality of river coal depends to a great extent on the preparation it receives after it is taken from the river. A large part of the river-coal output is not cleaned after the initial screening and washing, and it may contain some sand and gravel and be irregular in size, whereas the coal prepared over concentrating tables is clean and free from sand and gravel. Table 34 shows analyses of a combination of Barley and Buckwheat No. 4 coal dredged from the Susquehanna River near Harrisburg.

In the early days of the dredge industry, the sizes recovered were much larger than the coal taken from the rivers and creeks today; it was large enough so that considerable quantities could be used for domestic heating. As the methods of preparing coal at the breakers in the anthracite region were improved and new markets for the small sizes discovered, the coal finding its way into the rivers became smaller and smaller. In 1940, according to reports received by the Bureau of Mines, 83 percent of the river coal shipped was Buckwheat No. 3 or smaller. Domestic heating plants cannot burn such small coal without special equipment, and today virtually all of the river coal is sold for utility or industrial purposes.

TABLE 34.—*Proximate analyses of anthracite dredged from Susquehanna River, in percent*

[Air-dried; not tabled]

Sample	Moisture	Volatile matter	Fixed carbon	Ash	Total
1 [1]	3.6	6.6	68.8	21.0	100.0
2 [2]	3.3	6.9	71 4	18 4	100.0
3 [3]	3.5	6.7	73 9	15.9	100.0

[1] From river barges about 15 miles south of Harrisburg.
[2] From river barges at Harrisburg.
[3] From river barges three-fourths of a mile north of Harrisburg.

TABLE 35.—*Pennyslvania anthracite produced by dredges in 1941, by rivers*

River (including tributaries)	Net tons	Value	
		Total	Average
Lehigh	47,838	$57,217	$1.20
Schuylkill	396,522	489,187	1.23
Susquehanna	1,073,203	1,293,380	1.21
	1,517,563	1,839,784	1.21

Operations in 1941.—In 1941 dredge operators reported a production of 1,517,563 net tons with a value of $1,839,784. For detailed statistics by rivers, see table 35.

FOREIGN TRADE [4]

Data on imports and exports of anthracite in 1941 may be published for the first 9 months only. During this January–September period, exports totaled 2,416,104 net tons, whereas in the full calendar year 1940 exports were 2,667,632 tons. Imports in the 9-month period of 1941 were 64,267 tons and in the entire year 1940 135,436 tons. It will be noted that in each year a small proportion of the imported coal came from Canada; this tonnage, no doubt, represents re-exports. Details of imports and exports are shown in tables 36 and 37.

TABLE 36.—*Anthracite imported for consumption in the United States, 1940–41, by countries and customs districts, in net tons*

	1940	1941 (Jan.-Sept.)
Country		
Canada	3,026	948
United Kingdom	132,410	63,319
	135,436	64,267
Customs district		
Alaska		17,380
Connecticut	2,914	
Customs district—Con.		
Dakota	16	
Maine and New Hampshire	3,026	903
Massachusetts	101,200	39,210
Montana and Idaho		45
Rhode Island	28,280	6,729
	135,436	64,267

TABLE 37.—*Anthracite exported from the United States, 1937–41*

Year	Net tons	Value
1937	1,914,173	$14,795,748
1938	1,908,911	14,634,504
1939	2,590,000	19,919,651
1940	2,667,632	$21,210,499
1941 (Jan.-Sept.)	2,416,104	19,657,920

Canadian market.—Coal and lignite production in Canada in 1941 totaled 18,222,107 net tons (a 3.7-percent increase over 1940).

Coal available for consumption in Canada (production, plus imports, minus exports) totaled 39,499,519 tons and exceeded the 1918 record by 4,078,179 tons or 12 percent. Imports of bituminous coal increased 32 percent over 1940 and 3.4 percent over 1918. The quantity of anthracite imported was 0.6 percent less than in 1940.

Outstanding features of the coal and coke industry and foreign trade of Canada in 1940 and 1941 are shown in table 38.

Imports of coal in 1941 increased 24 percent over 1940 and were 20 percent greater than Canadian coal production.

Nova Scotia mines, which supplied 40 percent of the coal and lignite produced in 1941, operated at approximately 82 percent of capacity; and Alberta, which produced 38 percent of Dominion output, operated at about 83 percent of capacity.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Under normal conditions a large part of Nova Scotia coal production reaches its markets by steamers up the St. Lawrence River. The war necessitated requisitioning these vessels for trans-Atlantic trade and thus increased the burden on the Canadian National Railway.

TABLE 38.—*Coal and coke industry and foreign trade of Canada, 1940–41,[1] in thousands of net tons*

	Coal								Coke from coal	
	Anthracite		Bituminous and subbituminous		Lignite		Total			
	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941
Production			13,932	14,188	3,635	4,034	17,567	18,222	3,015	3,150
Imports	3,965	3,941	13,578	17,867	3	1	17,546	21,809	719	614
Exports			498	525	7	6	505	531	35	40
Available for consumption	3,965	3,941	27,012	31,530	3,631	4,029	34,608	39,500	3,699	3,724

[1] Quarterly Coal and Coke Statistics for Canada, 1940 and 1941 preliminary.

WORLD PRODUCTION

Statistics on world production of anthracite are incomplete because of unsettled conditions in foreign countries. Available data for 1936 to 1941 are shown in table 39.

TABLE 39.—*World production of anthracite, 1936–41, in metric tons*
[Compiled by B. B. Waldbauer]

Country	1936	1937	1938	1939	1940	1941
Belgium	6,077,907	6,694,049	6,874,520	(1)	(1)	(1)
Bulgaria	2,323	2,542	4,000	6,038	8,000	(1)
China	(2)	(1)	(1)	(1)	(1)	(1)
Chosen	1,051,853	1,101,500	1,664,000	2,064,000	(1)	(1)
France	8,227,000	(1)	(1)	(1)	(1)	(1)
Germany	5,511,000	5,627,000	(1)	(1)	(1)	(1)
Indochina	2,150,654	2,264,978	2,289,832	2,534,000	2,400,000	(1)
Irish Free State	96,742	106,651	92,157	90,455	74,170	(1)
Italy	79,972	95,060	132,197	100,000	(1)	(1)
Japan [3]	(2)	(1)	(1)	(1)	(1)	(1)
Morocco, French	49,388	107,150	123,200	115,600	[4] 143,000	(1)
Peru	3,535	2,918	1,500	3,514	4,500	5,000
Portugal	207,890	241,163	281,740	294,081	286,854	(1)
Rumania	3,708	3,646	3,266	(1)	(1)	(1)
Spain	309,930	407,838	496,000	666,000	1,098,050	[5] 533,000
Switzerland	3,000	4,000	3,000	2,500	[6] 7,000	(1)
U. S. S. R.:						
Asiatic	410,000	(1)	(1)	(1)	(1)	(1)
European	28,100,000	(1)	(1)	(1)	(1)	(1)
United Kingdom	6,629,955	6,437,465	6,378,904	(1)	(1)	(1)
United States	49,513,463	47,043,119	41,820,115	46,708,319	46,705,836	51,136,164
World total	113,733,463	(1)	(1)	(1)	(1)	(1)
Total, exclusive of United States	64,220,000	(1)	(1)	(1)	(1)	(1)

[1] Data not available.
[2] Estimate included in total.
[3] Anthracite output of Japan said to average about 225,000 tons a year. Production figures not available.
[4] Production of Djerada Basin only.
[5] January to June, inclusive.
[6] Estimated.

COKE AND BYPRODUCTS

By Robert H. Ridgway, J. A. De Carlo, and M. M. Otero

SUMMARY OUTLINE

SUMMARY

Responding to the demands of the defense program, production of coke in 1941 exceeded all previous records. Output from byproduct ovens—58,482,422 net tons (see table 1)—was the highest on record, and that from beehive ovens—6,704,156 tons—was more than double the quantity produced in 1940.

The total output from byproduct ovens (see table 2) exceeded by 4,468,113 tons the previous maximum of 54,014,309 tons established in 1940 and represented an 8-percent increase. Impelled by the need for more coke in the iron and steel industry, beehive-coke production rose from 3,057,825 tons in 1940 to 6,704,156 tons in 1941, an increase of 3,646,331 net tons or about 119 percent. (See fig. 1.)

The dominance of byproduct ovens was again emphasized, for even during a year of peak activity in the steel industry they contributed 90 percent of all coke consumed and the beehive ovens 10 percent. Byproduct ovens operated at 92 percent of estimated capacity for the year compared with 86 percent in 1940.

The value of sales of coke, breeze, tar, and other byproducts in 1941 totaled $536,147,279 and exceeded the 1940 total of $442,282,951 by $93,864,328, an increase of 21 percent.

Prices of coke per net ton sold by the producers increased sharply over 1940. Average receipts per ton of coke sold by the producers were: Furnace coke, $5.63, an increase of $1.23 over 1940 (28 percent); foundry coke, $9.35, exceeded the 1940 figure by $1.07; coke used in the manufacture of water gas, $6.74 compared with $5.99 for 1940; and domestic coke, $6.93, an increase of $0.93 over 1940. Coke used for other industrial purposes, at $6.38, showed an increase of $0.96.

Coke screenings or breeze produced in 1941 totaled 4,554,513 tons and surpassed the 1940 production by 389,060 tons. The increase was accompanied by an increase in average receipts, as the $2.35 realized per ton was $0.11 higher than the amount received in 1940.

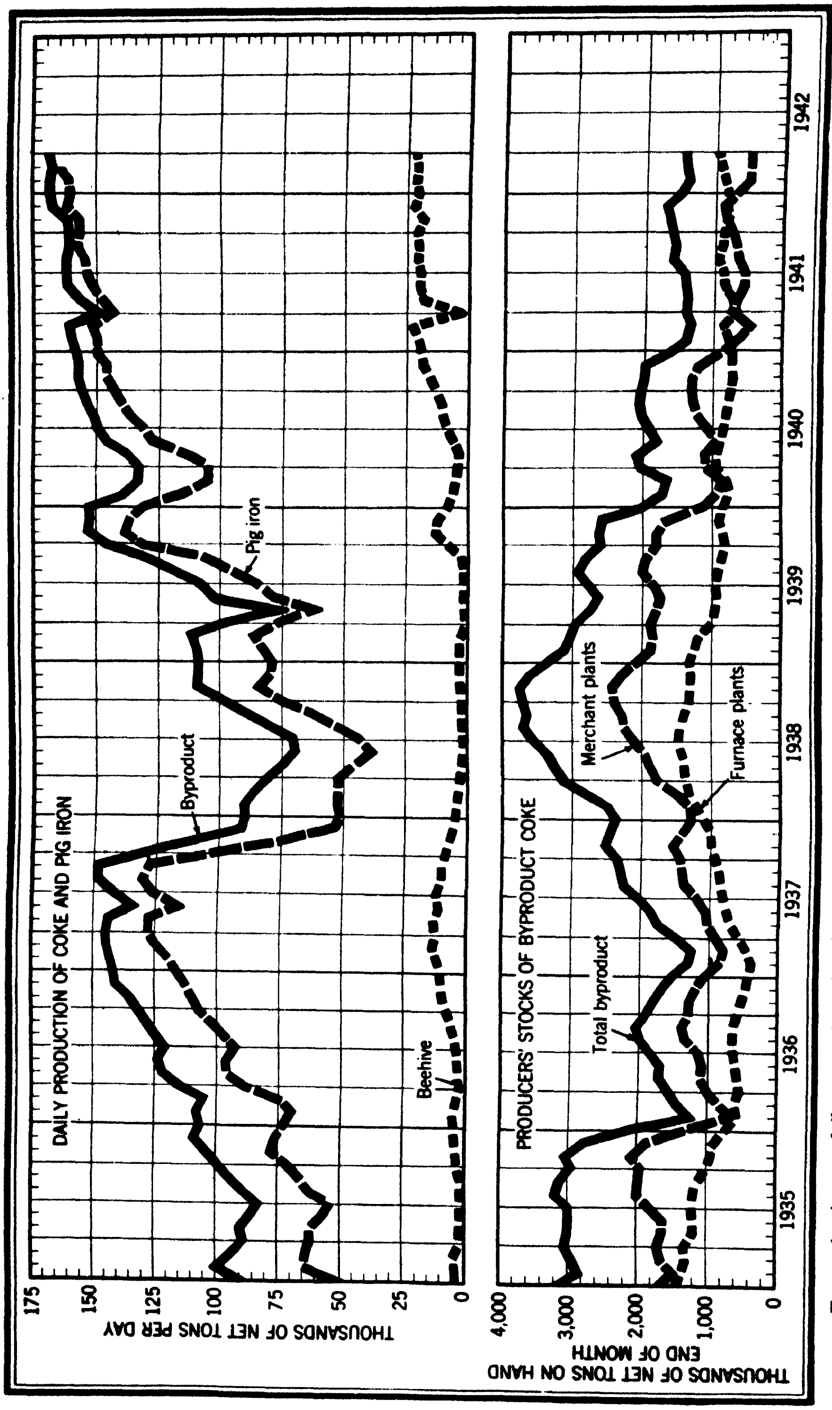

FIGURE 1.—Average daily production of beehive and byproduct coke and pig iron; and producers' stocks of byproduct coke, 1935–42, by months.

According to the principal uses to which it is put, coke may be classified as (1) blast-furnace coke; (2) foundry coke; (3) domestic coke; (4) coke for all other industrial uses, including water-gas coke. Coke used in blast furnaces totaled 50,454,325 net tons, an all-time high, compared with 42,483,624 net tons in 1940, an increase of 7,970,701 tons (19 percent). Coke sold for domestic purposes dropped 1,548,054 tons in 1941—6,682,959 tons against 8,231,013 tons in 1940—and emphasized the demand by the iron and steel industry. Sales of foundry coke increased sharply; 1941 sales of 2,846,459 tons exceeded the 1940 figure by 756,497 tons (36 percent). Coke sold for other purposes, including all other industrial uses, totaled 5,390,123 tons.

The consumption of coke in 1941 was the highest ever recorded—65,101,401 tons, or 8,075,155 tons above 1940.

The increased production of byproduct coke substantially increased the output of the major byproducts gas, tar, light oil, and ammonia. The average yield of each of the principal byproducts recovered per ton of coal carbonized declined a little from 1940, owing to shorter coking time. The unit prices received for the coke byproducts varied only slightly from those of 1940. The value of the coke byproducts produced was $158,809,184.

The total output of gas from byproduct ovens was 892,819,811 M cubic feet compared with 833,761,720 M cubic feet in 1940. Total tar produced amounted to 704,149,468 gallons compared with 673,286,517 gallons in 1940. Ammonium sulfate or equivalent showed a marked increase in production—1,741,503,884 pounds against 1,664,217,195 pounds in 1940. The output of crude light oil in 1941 surpassed the 215,213,667 gallons recovered in 1940.

Tables 1 and 2 present the principal statistical facts of the coke industry in 1941.

GOVERNMENT CONTROL MEASURES

During the calendar year 1941, activities of the Office of Production Management (now the War Production Board) relative to coke consisted in approving projects for new byproduct-coke plants necessary to supply blast-furnace coke for the expanded program of iron production for the iron and steel industries. In all, 443 new byproduct ovens were put into operation in 1941. Of these, 171 were constructed for merchant plants, 235 for iron and steel producers, and 37 for gas producers.

Maximum prices for byproduct foundry and byproduct blast-furnace coke were established in 1941 by the Office of Price Administration in Price Schedule 29, published September 20, 1941, in the Federal Register (No. 184, vol. 6, title 32, pp. 4821–4822). The prices became effective on and after October 1, 1941, and under general provisions (*a*) in appendix A of Price Schedule 29, the maximum prices of byproduct foundry coke are given for the various established coke markets.

Ceiling prices for byproduct foundry coke were established as follows:

Location of plant:	F. o. b. oven plant in cars (per net ton)
Alabama	$8.50
Ashland, Ky	10.00
Chicago, Ill	11.50
Detroit, Mich	11.75
Kearny, N. J	12.15
Buffalo, N. Y	11.75
Ironton, Ohio	10.00
Painesville, Ohio	11.25
Portsmouth, Ohio	10.00
Erie, Pa	11.75
Philadelphia, Pa	11.75
Chattanooga, Tenn	9.00
Fairmont, W. Va	10.00
Milwaukee, Wis	12.25

However, the complexity of the price structure was recognized; several exceptions to the general provisions were made and are shown in section (b) of appendix A. Amendment 1 of Price Schedule 29 was issued February 2, 1942, effective February 7, 1942, to describe the areas governed by specific oven prices so that they would conform with the industry's established practice; it did not affect the prices in Schedule 29. This amendment appeared in the February 4, 1942, issue of the Federal Register, (No. 24, vol. 7, title 32, p. 721). Appendix B of Price Schedule 29 outlines the maximum prices governing byproduct blast-furnace coke.

With only partial control of coke prices in effect, pressure was brought to bear upon the iron and steel industry by the rise in price of beehive-oven blast-furnace coke, which resulted in a thorough survey of the beehive-coke industry. As a result of study of the relationship between price and available supply of beehive coke, the Office of Price Administration in 1941 issued Price Schedule 77, which appeared in the Federal Register (No. 18, vol. 7, title 32, pp. 545-546) issued January 27, 1942, and effective on and after January 26, 1942. This price schedule established the maximum prices for beehive-oven furnace coke produced in Pennsylvania. Over 88 percent of the entire beehive-coke output was produced in Pennsylvania during the past year. Maximum prices on beehive coke other than Pennsylvania beehive blast-furnace coke were established by Maximum Price Schedule 121, effective May 18, 1942, which appeared in the Federal Register (Nos. 85–105, vol. 7, title 32, pp. 3237–3989 and 4483).

The activities of the Office of Production Management in 1941 with regard to coke byproducts centered on the available supply of and the requirements for the essential war products derived therefrom. The first control measure that became effective in 1941 concerning the supply and distribution of toluol was shown in the Federal Register (No. 171, vol. 6, title 32, pp. 4532–4533), issued and effective August 28, 1941; it related to conservation of supplies and directed distribution. Amendment 1, shown December 31, 1941, in the Federal Register (No. 253, vol. 6, title 32, p. 6853) placed further restrictions on uses, allocated supply, and extended the order indefinitely.

Phenol was another byproduct on which control measures were issued. Deliveries and acceptance were placed under the Director

of Priorities and appeared on September 3, 1941, in the Federal Register (No. 171, vol. 6, title 32, p. 4527), and the order was effective as of August 30, 1941. Amendment 1, issued and effective November 10, 1941, was shown in the Federal Register (No. 200, vol. 6, title 32, p. 5730).

Restrictions on the export of a large number of materials derived from the byproducts obtained from coke ovens became effective in 1941. The President of the United States, by proclamation, placed restrictions on the exportation of many coal-tar derivatives. The complete text of the proclamation appeared April 1, 1941, in the Federal Register (No. 63, vol. 6, title 32, p. 1703).

The necessity for controlling exports of important and essential materials derived from coke byproducts resulted in the issuance of Export-Control Schedules 1 and 2 by the Director of Export Control. Schedule 1, issued March 15, 1941, and effective April 15, 1941, was printed in the March 21, 1941, issue of the Federal Register (No. 56, vol. 6, title 32, ch. 8, p. 1540). Schedule 2, issued April 1, 1941, effective April 15, 1941, appeared in the April 8, 1941, issue of the Federal Register (No. 68, vol. 6, title 32, p. 1815).

TABLE 1.—*Salient statistics of the coke industry in 1941*

	Byproduct	Beehive	Total
Coke produced—			
At merchant plants:			
Quantity net tons	13,494,509		13,494,509
Value	$96,343,846		$96,343,846
At furnace plants:			
Quantity net tons	44,987,913		44,987,913
Value	$220,133,385		$220,133,385
Total			
Quantity net tons	58,482,422	6,704,156	65,186,578
Value	$316,477,231	$36,490,006	$352,967,237
Screenings or breeze produced:			
Quantity net tons	4,432,864	121,649	4,554,513
Value	$9,530,433	$131,570	$9,662,003
Coal charged into ovens:			
Quantity net tons	82,608,837	10,529,316	93,138,153
Value	$323,530,081	$24,541,962	$348,072,043
Average value per ton	$3 92	$2.33	$3.74
Average yield in percent of coal charged:			
Coke	70 79	63 67	69.99
Breeze (at plants actually recovering)	5 41	2.43	5.24
Ovens:			
In existence January 1	12,734	15,150	27,884
In existence December 31	13,016	[1] 18,609	31,685
Dismantled during year	158	286	444
In course of construction December 31	181		181
Annual capacity of ovens December 31 net tons	62,562,348	11,209,851	73,772,199
Coke used by producer—			
In blast furnaces:			
Quantity net tons	39,137,521	1,011,724	40,149,245
Value	$190,331,548	$4,957,622	$195,289,170
To make producer gas:			
Quantity net tons	772,720		772,720
Value	$4,562,760		$4,562,760
To make water gas:			
Quantity net tons	1,174,279		1,174,279
Value	$6,142,787		$6,142,787
For other purposes:			
Quantity net tons	445,878	4,028	449,906
Value	$2,431,872	$20,145	$2,452,017
Disposal of coke:			
Sold to financially affiliated corporations—			
For blast-furnace use:			
Quantity net tons	3,690,730	962,586	4,653,316
Value	$18,009,551	$4,759,191	$22,768,742
For other purposes:			
Quantity net tons	707,118	8,502	715,620
Value	$4,161,299	$42,107	$4,203,406

See footnotes at end of table.

TABLE 1.—*Salient statistics of the coke industry in 1941*—Continued

	Byproduct	Beehive	Total
Disposal of coke—Continued.			
Sold to other consumers—			
For blast-furnace use:			
Quantity net tons	1,817,753	3,834,011	5,651,764
Value	$10,367,313	$21,478,978	$31,846,291
For foundry use:			
Quantity net tons	2,494,393	352,066	2,846,459
Value	$24,342,509	$2,283,630	$26,626,139
For manufacture of water gas:			
Quantity net tons	542,073	85,926	627,999
Value	$3,827,345	$405,080	$4,232,425
For other industrial use:			
Quantity net tons	1,302,053	347,546	1,649,599
Value	$8,482,456	$2,040,539	$10,522,995
For domestic use:			
Quantity net tons	6,596,969	85,990	6,682,959
Value	$45,910,660	$424,736	$46,335,396
Disposal of screenings or breeze.			
Used by producer—			
For raising steam:			
Quantity net tons	3,335,705	35,925	3,371,630
Value	$6,962,011	$52,395	$7,014,406
To make producer or water gas.			
Quantity net tons	46,852		46,852
Value	$151,051		$151,051
For other purposes:			
Quantity net tons	381,206	780	381,986
Value	$731,095	$1,308	$732,403
Sold:			
Quantity net tons	836,159	32,963	869,122
Value	$2,014,560	$31,158	$2,045,718
Average receipts per ton sold:			
Furnace coke (merchant sales)	$5 70	$5 60	$5.63
Foundry coke	$9 76	$6 49	$9 35
For manufacture of water gas	$7 06	$4 71	$6 74
Other industrial coke	$6 51	$5 87	$6 38
Domestic coke	$6 96	$4 94	$6 93
Screenings or breeze	$2 41	$0.95	$2 35
Stocks on hand January 1, 1942.			
Furnace net tons	697,898	20,311	718,209
Foundry do	20,448	4,987	25,435
Domestic and other do	991,045	23,397	1,014,442
Screenings or breeze do	443,366	1,682	445,048
Exports do			[2] 525,223
Imports do			[2] 241,690
Calculated consumption do			[3] 65,101,401
Byproducts produced:			
Gas M cubic feet	892,819,811		892,819,811
Wasted percent	1 18		1.18
Burned in coking process do	36 75		36 75
Surplus sold or used do	62.07		62 07
Tar gallons	704,149,468		704,149,468
Ammonium sulfate or equivalent pounds	1,741,503,884		1,741,503,884
Yield of byproducts per ton of coal			
Gas M cubic feet	10 81		10 81
Tar gallons	8 52		8.52
Ammonium sulfate or equivalent pounds	21 34		21.34
Value of byproducts sold			
Gas (surplus)	$85,040,609		$85,040,609
Tar.			
Sold	$18,386,170		$18,386,170
Used by producer	$14,708,855		$14,708,855
Ammonium sulfate or equivalent	$21,709,619		$21,709,619
Crude light oil and derivatives	$23,668,801		$23,668,801
Other byproducts [4]	$10,003,985		$10,003,985
Total value of coke and breeze produced and byproducts sold [5]	$499,525,703	$36,621,576	$536,147,279

[1] Increase in number of ovens in existence is due to number of old ovens previously reported abandoned that were rehabilitated in 1941.
[2] Figures cover January to September, inclusive
[3] Subject to revision. Includes net difference between imports and exports for first 9 months only.
[4] Includes naphthalene and tar derivatives.
[5] Includes value of tar used by producer.

TABLE 2.—*Statistical trends of the coke industry in the United States, 1923 and 1938–41*

	1923	1938	1939	1940	1941
Coke produced:					
Beehive net tons	19,379,870	837,412	1,444,328	3,057,825	6,704,156
Byproduct do	37,597,664	31,658,403	42,882,313	54,014,309	58,482,422
Total do	56,977,534	32,495,815	44,326,641	57,072,134	65,186,578
Percent of total from byproduct ovens	66.0	97.4	96.7	94.6	89.7
Stocks of producers, end of year, all coke net tons	[1] 1,221,737	3,676,554	2,602,099	1,956,442	1,758,086
Exports, all coke do	1,237,342	486,571	589,925	804,095	[2] 525,223
Imports, all coke [3] do	85,002	135,240	141,911	112,550	[2] 241,690
Consumption, calculated, all coke do	55,173,457	31,063,217	44,953,082	57,026,246	[4] 65,101,401
Disposal of coke, all coke sold or used:					
Furnace coke net tons	47,774,408	19,070,186	31,498,557	42,483,624	50,454,325
Foundry coke do	3,600,719	1,215,780	1,682,200	2,089,962	2,846,459
Other industrial (including water gas) net tons	[5] 2,283,888	2,786,710	3,193,068	3,581,676	4,224,597
Domestic coke do	2,733,414	7,222,690	7,638,141	8,231,013	6,682,959
For all other purposes do	(5)	1,175,346	1,311,559	1,458,435	1,165,526
Ovens:					
Beehive, in existence, end of year	62,349	10,816	10,934	15,150	18,669
Byproduct, in existence, end of year	11,156	12,724	12,732	12,734	13,016
Byproduct under construction, end of year	629	146	....	492	181
Cost of coal charged, byproduct ovens, average per ton	$4.76	$3.92	$3.75	$3.68	$3.92
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$5.33	$3.86	$4.09	$4.42	$5.92
Average realization on byproduct coke sold:					
Furnace coke (merchant sales)	$6.74	$4.41	$4.38	$4.55	$5.70
Foundry coke	$10.54	$8.39	$8.15	$8.67	$9.76
Other industrial (including water gas)	$9.06	$5.68	$5.64	$5.86	$6.68
Domestic	$9.05	$6.17	$5.90	$6.03	$6.96
Yield of byproducts per ton of coal charged:					
Tar gallons	8.1	9.27	9.06	8.79	8.52
Ammonium sulfate or equivalent pounds	21.2	23.36	22.33	22.00	21.34
Light oil gallons	2.7	2.99	2.99	2.93	(6)
Surplus gas sold or used M cubic feet	5.9	7.14	7.08	6.84	6.71
Average gross receipts for byproducts, per ton of coke produced:					
Tar sold and used	$0.51	$0.654	$0.622	$0.571	$0.566
Ammonia and its compounds	$0.84	$0.380	$0.341	$0.364	$0.371
Light oil and its derivatives (including naphthalene)	$0.51	$0.423	$0.414	$0.421	(6)
Surplus gas sold or used	$1.37	$1.907	$1.676	$1.507	$1.454
Total byproducts, including breeze	$3.48	$3.647	$3.315	$3.117	$3.130

[1] Furnace and foundry coke only.
[2] Figures cover January to September, inclusive.
[3] Before 1934, figures represent general imports; beginning with 1934, they represent imports for consumption only.
[4] Subject to revision. Includes net difference between imports and exports for first 9 months only.
[5] "For all other purposes" included under "Other industrial (including water gas)."
[6] Figures withheld in accordance with Government policy.

SCOPE OF REPORT

This report presents, by means of selected tables, the essential facts concerning the 1941 production of byproduct and beehive coke (tables 3 to 45), coke breeze (table 26), coke byproducts (tables 46 to 51), and city-gas company statistics (table 52). In addition to the customary annual data, the report embodies the result of a survey of coking coal, which shows the State and county of origin, the tonnage supplied by the principal counties, and the percentage of total State tonnages by seams. As a result of a survey covering 1941, statistics showing the consumption of foundry coke in the United States, by States and regions, appear in this chapter for the first time.

Coke is produced by a group of four different industries in the United States. Most of the output comes from byproduct and beehive ovens, but small quantities are also made by petroleum refineries, coal-gas retorts, and tar refineries. The coke manufactured by each of these industries, however, varies greatly in character, and the problems affecting each are separate and distinct.

About 1,648,800 tons of petroleum coke and 91,800 tons of coal-tar pitch coke were produced in 1941 compared with 1,526,600 and 90,906 tons, respectively, in 1940. The tonnage of coke produced in coal-gas retorts is relatively small, and the 1941 figure is not available at present.

Only coke made from byproduct and beehive ovens is suitable for blast-furnace and foundry uses. As the metallurgical industries consume the bulk of all coke produced, the trade is concerned chiefly with byproduct and beehive coke, and the statistics of this report are confined to these two types.

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified that unit is employed throughout this report.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 3.—*Byproduct, beehive, and total coke produced in the United States, 1938–41, by months and average per day, in net tons*

Month	1938		1939		1940		1941	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct.								
January	2,749,100	88,700	3,355,200	108,200	4,720,600	152,300	4,938,800	159,300
February	2,481,600	88,600	3,066,800	109,500	4,028,300	138,900	4,507,400	161,000
March	2,661,700	85,900	3,425,700	110,500	4,136,600	133,400	5,005,200	161,500
April	2,424,100	80,800	2,903,800	96,800	3,995,800	133,200	4,479,600	149,300
May	2,272,100	73,300	2,387,100	77,000	4,256,000	137,300	4,851,600	156,500
June	2,056,300	68,500	3,078,500	102,600	4,387,200	146,200	4,841,700	161,400
July	2,166,100	69,900	3,354,100	108,200	4,632,400	149,400	5,019,600	161,900
August	2,484,000	80,100	3,652,900	117,800	4,695,500	151,500	5,018,900	161,900
September	2,665,100	88,800	3,890,600	129,700	4,640,700	154,700	4,811,400	160,400
October	3,081,200	99,400	4,512,300	145,600	4,853,600	156,600	4,976,500	160,500
November	3,266,300	108,900	4,551,900	151,700	4,763,500	158,800	4,839,200	161,300
December	3,350,800	108,100	4,703,400	151,700	4,904,100	158,200	5,192,500	167,500
	31,658,400	86,700	42,882,300	117,500	54,014,300	147,600	58,482,400	160,200
Beehive:								
January	114,100	4,400	78,400	3,000	252,300	9,300	542,500	17,500
February	102,200	4,300	72,000	3,000	164,400	6,600	523,900	18,700
March	95,200	3,500	69,600	2,600	143,100	5,500	618,100	19,900
April	73,100	2,800	20,000	800	108,400	4,200	98,200	3,300
May	56,700	2,200	24,700	900	112,300	4,200	571,200	18,400
June	49,800	1,900	52,300	2,000	159,800	6,400	595,400	19,800
July	42,000	1,700	47,100	1,900	244,400	9,400	610,400	19,700
August	47,700	1,800	44,900	1,700	294,200	10,900	644,500	20,800
September	53,600	2,100	77,000	3,000	287,800	11,500	605,800	20,200
October	60,700	2,300	266,800	10,300	384,200	14,200	646,800	20,900
November	66,700	2,600	362,700	14,000	416,800	16,000	561,300	18,700
December	75,600	2,900	328,800	13,200	490,100	19,600	686,100	22,100
	837,400	2,700	1,444,300	4,700	3,057,800	9,800	6,704,200	18,400
Total coke:								
January	2,863,200	93,100	3,433,600	111,200	4,972,900	161,600	5,481,300	176,800
February	2,583,800	92,900	3,138,800	112,500	4,192,700	145,500	5,031,300	179,700
March	2,756,900	89,400	3,495,300	113,100	4,279,700	138,900	5,623,300	181,400
April	2,497,200	83,600	2,923,800	97,600	4,104,200	137,400	4,577,800	152,600
May	2,328,800	75,500	2,411,800	77,900	4,368,300	141,500	5,422,800	174,900
June	2,106,100	70,400	3,130,800	104,600	4,547,000	152,600	5,437,100	181,200
July	2,208,100	71,600	3,401,200	110,100	4,876,800	158,800	5,630,000	181,600
August	2,531,700	81,900	3,697,800	119,500	4,989,700	162,400	5,663,400	182,700
September	2,718,700	90,900	3,967,600	132,700	4,928,500	166,200	5,417,200	180,600
October	3,141,900	101,700	4,779,100	155,900	5,237,800	170,800	5,623,300	181,400
November	3,333,000	111,500	4,914,600	165,700	5,180,300	174,800	5,400,500	180,000
December	3,426,400	111,000	5,032,200	164,900	5,394,200	177,800	5,878,600	189,600
	32,495,800	89,400	44,326,600	122,200	57,072,100	157,400	65,186,600	178,600

TABLE 4.—*Beehive coke produced in the United States in 1941, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 4	[1] 61,700	May 17	133,600	Sept. 27	143,800
11	113,900	24	155,600	Oct. 4	136,900
18	126,800	31	131,300	11	131,700
25	119,100	June 7	128,600	18	165,300
Feb. 1	145,300	14	158,000	25	154,400
8	129,400	21	136,300	Nov. 1	124,900
15	132,800	28	148,300	8	139,600
22	131,200	July 5	121,400	15	144,700
Mar. 1	127,500	12	136,000	22	112,700
8	145,800	19	128,400	29	143,400
15	147,600	26	154,800	Dec. 6	157,100
22	145,700	Aug. 2	141,100	13	141,300
29	144,800	9	145,900	20	157,600
Apr. 5	78,700	16	145,900	27	154,800
12	7,400	23	165,600	28–31 [1]	75,200
19	8,200	30	140,000		
26	7,200	Sept. 6	143,100		6,704,200
May 3	41,300	13	133,700		
10	119,200	20	140,100		

[1] 4 days only.

TABLE 5.—*Byproduct coke produced in the United States in 1941, by months and States, in net tons*

[Based upon reports from all producers]

State	January	February	March	April	May	June	July
Alabama	405,000	381,400	424,800	345,700	381,300	421,800	435,700
Colorado	54,400	49,700	53,400	49,100	54,000	47,600	52,200
Illinois	306,900	286,300	322,300	251,600	308,800	298,700	314,900
Indiana	616,800	594,700	636,600	552,500	632,800	623,400	658,500
Maryland	144,200	130,500	148,100	142,100	147,500	142,400	146,600
Massachusetts	100,600	91,200	100,500	89,700	97,100	98,300	92,400
Michigan	253,700	231,900	261,800	202,200	220,000	238,300	252,800
Minnesota	46,700	42,000	48,400	47,100	51,000	51,200	53,100
New Jersey	88,400	80,200	88,200	84,400	88,100	83,700	88,100
New York	445,300	361,500	423,700	417,000	430,200	419,800	423,100
Ohio	784,400	716,100	795,900	695,500	761,100	765,100	794,200
Pennsylvania	1,329,300	1,205,100	1,330,500	1,253,100	1,308,800	1,280,200	1,324,000
Tennessee	8,800	8,000	8,900	9,200	9,900	8,300	8,700
Utah	19,700	18,300	21,000	15,600	20,600	19,700	20,300
West Virginia	156,200	150,000	166,600	159,500	166,600	162,200	168,600
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	178,400	160,500	174,500	165,300	173,800	181,000	186,400
	4,938,800	4,507,400	5,005,200	4,479,600	4,851,600	4,841,700	5,019,600
At merchant plants	1,113,600	1,039,200	1,154,800	1,055,900	1,119,800	1,113,200	1,144,000
At furnace plants	3,825,200	3,468,200	3,850,400	3,423,700	3,731,800	3,728,500	3,875,600

State	August	September	October	November	December	Total
Alabama	433,000	334,900	380,800	342,200	473,200	4,759,800
Colorado	52,000	48,200	54,300	52,900	55,000	622,800
Illinois	319,300	310,500	318,900	306,900	315,800	3,660,900
Indiana	640,300	614,200	591,600	605,500	689,800	7,406,700
Maryland	146,500	142,700	147,100	142,300	172,500	1,752,500
Massachusetts	92,300	97,100	101,100	99,200	102,200	1,161,700
Michigan	236,400	231,200	235,100	243,200	257,000	2,863,600
Minnesota	53,000	63,400	77,400	75,200	77,400	685,900
New Jersey	87,800	84,000	88,000	83,500	87,200	1,031,600
New York	414,600	433,000	444,000	446,000	458,100	5,116,300
Ohio	803,800	777,200	805,300	774,200	811,400	9,284,200
Pennsylvania	1,348,600	1,297,700	1,337,400	1,281,800	1,335,800	15,632,300
Tennessee	9,800	9,000	9,300	9,300	12,100	111,300
Utah	20,700	19,200	20,800	19,500	21,200	236,600
West Virginia	170,500	166,200	172,000	168,100	177,100	1,983,600
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	190,300	182,900	193,400	189,400	196,700	2,172,600
	5,018,900	4,811,400	4,976,500	4,839,200	5,192,500	58,482,400
At merchant plants	1,143,400	1,103,000	1,148,600	1,144,400	1,214,600	13,494,500
At furnace plants	3,875,500	3,708,400	3,827,900	3,694,800	3,977,900	44,987,900

TABLE 6.—*Beehive coke produced in the United States in 1941, by months and States, in net tons*

[Based upon railroad shipments]

State	January	February	March	April	May	June
Alabama						3,400
Colorado and Utah	7,200	6,800	7,800	3,600	6,500	7,800
Kentucky and Tennessee	3,600	3,300	3,900	2,800	4,600	3,900
Pennsylvania	480,600	465,400	548,200	85,200	509,400	526,800
Virginia	26,800	27,000	31,600	2,900	28,900	29,300
West Virginia	24,300	21,400	26,600	3,700	21,800	24,200
	542,500	523,900	618,100	98,200	571,200	595,400

State	July	August	September	October	November	December	Total
Alabama	13,800	17,500	12,300	14,100	15,000	19,100	95,200
Colorado and Utah	7,400	7,800	8,800	9,200	8,700	8,800	90,400
Kentucky and Tennessee	3,800	2,700	2,500	3,600	2,900	3,600	41,200
Pennsylvania	535,000	560,900	530,800	563,400	484,600	600,800	5,891,100
Virginia	27,600	29,400	29,500	32,800	29,600	29,200	324,600
West Virginia	22,800	26,200	21,900	23,700	20,500	24,600	261,700
	610,400	644,500	605,800	646,800	561,300	686,100	6,704,200

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

The terms "furnace" and "merchant" plants originated in the Connellsville beehive-coke trade, although in this report the distinction is applied to byproduct-coke plants only. Furnace plants are those affiliated with the iron and steel industry, with an output that does not ordinarily enter the open market. Merchant plants include some that are affiliated with local iron furnaces but produce more coke than the furnaces can consume and therefore depend on foundry, domestic, or other markets. The term also includes producers of coke who sell their entire output on the competitive market; the plants affiliated with alkali works; low-temperature carbonization plants; and, in addition, a number of plants that, although not public utilities, were constructed primarily to supply city gas and sell their coke for domestic, industrial, and metallurgical use.

Production of coke follows closely the trend of the iron and steel industry. In 1941, 45 furnace plants produced 44,987,913 tons of coke (77 percent), and 42 nonfurnace plants produced only 13,494,509 tons (23 percent) of the total, which was the same ratio as in 1940.

TABLE 7.—*Number and production of byproduct-coke plants connected with iron furnaces and of other byproduct plants in the United States, 1913, 1918, and 1939–41*

Year	Number of active plants		Coke produced (net tons)		Percent of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
1913	20	16	9,277,832	3,436,868	73 0	27.0
1918	36	24	19,220,342	6,777,238	73.9	26.1
1939	45	39	31,811,807	11,070,506	74.2	25.8
1940	45	40	41,465,177	12,549,132	76 8	23.2
1941	45	42	44,987,913	13,494,509	76.9	23.1

TABLE 8.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants in the United States, 1939–41, in net tons*

Month	1939		1940		1941	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	2,388,000	967,200	3,644,300	1,076,300	3,825,200	1,113,600
February	2,199,000	867,800	3,038,200	990,100	3,468,200	1,039,200
March	2,495,000	930,700	3,082,700	1,053,900	3,850,400	1,154,800
April	2,045,700	858,100	2,985,700	1,010,100	3,423,700	1,055,900
May	1,625,900	761,200	3,248,200	1,007,800	3,731,800	1,119,800
June	2,230,200	848,300	3,395,800	991,400	3,728,500	1,113,200
July	2,480,600	873,500	3,599,800	1,032,600	3,875,600	1,144,000
August	2,759,900	893,000	3,658,800	1,036,700	3,875,500	1,143,400
September	2,960,400	930,200	3,596,900	1,043,800	3,708,400	1,103,000
October	3,463,300	1,049,000	3,750,800	1,102,800	3,827,900	1,148,600
November	3,526,400	1,025,500	3,674,700	1,088,800	3,694,800	1,144,400
December	3,637,400	1,066,000	3,789,300	1,114,800	3,977,900	1,214,600
	31,811,800	11,070,500	41,465,200	12,549,100	44,987,900	13,494,500
Average daily production:						
January	77,000	31,200	117,600	34,700	123,400	35,900
February	78,500	31,000	104,800	34,100	123,900	37,100
March	80,500	30,000	99,400	34,000	124,200	37,300
April	68,200	28,600	99,500	33,700	114,100	35,200
May	52,400	24,600	104,800	32,500	120,400	36,100
June	74,300	28,300	113,200	33,000	124,300	37,100
July	80,000	28,200	116,100	33,300	125,000	36,900
August	89,000	28,800	118,000	33,500	125,000	36,900
September	98,700	31,000	119,900	34,800	123,600	36,800
October	111,700	33,900	121,000	35,600	123,500	37,000
November	117,500	34,200	122,500	36,300	123,200	38,100
December	117,300	34,400	122,200	36,000	128,300	39,200
Average	87,200	30,300	113,300	34,300	123,200	37,000

PRODUCTION BY STATES AND DISTRICTS

All coke-producing States except Michigan increased their output in 1941. The total output of byproduct coke (exclusive of screenings and breeze) in 1941 was 8 percent greater than in 1940, and the output of beehive coke was 119 percent greater than in 1940.

As in previous years, Pennsylvania was the leading producing State, contributing 27 percent of the byproduct and 88 percent of the beehive output. The largest gains were reported by Minnesota with an increase of 31 percent, Illinois with 21 percent, Tennessee and Ohio each with 18 percent, Indiana with 16 percent, and Colorado with 15 percent over the 1940 output.

The rehabilitation and operation during 1941 of a large number of beehive ovens that had long been idle partly explained the increased beehive-coke production. Alabama manufactured beehive coke in 1941 for the first time in many years. All producing States shared the increase in beehive-coke output. Pennsylvania produced approximately 88 percent of the Nation's total; Virginia, West Virginia, Alabama, and Colorado together contributed 11 percent; and all other States furnished only 1 percent (table 9.)

TABLE 9.—*Byproduct and beehive coke produced in the United States, 1918 and 1938–41, by States, in net tons*

[Exclusive of screenings or breeze]

State	1918	1938	1939	1940	1941
Byproduct:					
Alabama	2, 634, 451	3, 378, 044	3, 854, 505	4, 727, 378	4, 759, 862
Colorado	280, 663	186, 805	398, 033	543, 548	622, 807
Connecticut		(1)	(1)	(1)	(1)
Illinois	2, 285, 610	1, 734, 511	1, 884, 240	3, 014, 840	3, 660, 878
Indiana	3, 898, 215	2, 904, 779	4, 878, 033	6, 412, 716	7, 406, 724
Kentucky	517, 749	(1)	(1)	(1)	(1)
Maryland	474, 368	1, 105, 262	1, 578, 973	1, 682, 701	1, 752, 538
Massachusetts	556, 397	1, 019, 302	1, 057, 158	1, 130, 311	1, 161, 732
Michigan	(1)	1, 742, 787	2, 430, 688	2, 872, 026	2, 863, 563
Minnesota	784, 065	540, 447	497, 079	524, 360	685, 873
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682, 148	1, 007, 394	1, 003, 197	1, 016, 481	1, 031, 569
New York	1, 069, 587	3, 945, 358	4, 468, 437	5, 080, 403	5, 116, 308
Ohio	5, 226, 334	3, 699, 995	6, 135, 949	7, 897, 929	9, 284, 194
Pennsylvania	4, 586, 981	7, 119, 328	10, 994, 254	14, 861, 657	15, 632, 354
Rhode Island		(1)	(1)	(1)	(1)
Tennessee	124, 469	76, 123	79, 448	94, 454	111, 310
Utah		132, 513	189, 194	218, 949	236, 607
Washington	30, 129				
West Virginia	603, 393	1, 346, 734	1, 598, 198	1, 899, 849	1, 983, 619
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2, 293, 021	1, 719, 021	1, 834, 927	2, 036, 707	2, 172, 484
	25, 997, 580	31, 658, 403	42, 882, 313	54, 014, 309	58, 482, 422
Beehive:					
Alabama	1, 717, 721				95, 200
Colorado	758, 784	54, 721	56, 836	62, 417	80, 196
Georgia	22, 048				
Kentucky	301, 036			(1)	2, 054
New Mexico	597, 072				
Ohio	138, 909				
Oklahoma	(1)				
Pennsylvania	22, 136, 664	482, 105	1, 125, 971	2, 550, 367	5, 891, 118
Tennessee	302, 637	5, 500		5, 251	39, 083
Utah	(1)	7, 668	8, 332	7, 398	10, 244
Virginia	1, 234, 256	133, 905	165, 317	198, 379	324, 573
Washington	93, 659			(1)	
West Virginia	2, 716, 613	153, 513	87, 872	233, 154	261, 688
Combined States	461, 393			859	
	30, 480, 792	837, 412	1, 444, 328	3, 057, 825	6, 704, 156
Grand total	56, 478, 372	32, 495, 815	44, 326, 641	57, 072, 134	65, 186, 578

[1] Included under "Combined States."

TABLE 10.—*Coke produced, value, number of ovens, coal charged, and average yield in 1941, by States*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
						Total	Per ton					Total	Per ton		
Alabama	8	1,352	6,656,387	71.51	4,759,862	$18,026,799	$3 79	545	156,940	60.66	95,200	$601,735	$6.32	4,855,062	$18,628,534
Colorado	1	188	956,279	65.13	622,807	(1)	(1)	260	124,198	64.57	80,196	(1)	(1)	703,003	(1)
Illinois	9	915	5,141,881	71.20	3,660,878	25,214,769	6 89							3,660,878	25,214,769
Indiana	5	1,452	10,103,930	73.31	7,406,724	48,432,824	6 54							7,406,724	48,432,824
Maryland	1	422	2,413,996	72 60	1,752,538	(1)	(1)							1,752,538	(1)
Massachusetts	2	215	1,651,177	70.36	1,161,732	(1)	(1)							1,161,732	(1)
Michigan	8	660	4,015,810	71 31	2,863,563	18,213,048	6.36							2,863,563	18,213,048
Minnesota	3	196	950,812	72.13	685,873	5,082,787	7 41							685,873	5,082,787
New Jersey	2	239	1,439,711	71 65	1,031,569	(1)	(1)							1,031,569	(1)
New York	8	1,054	7,166,526	71 39	5,116,308	32,808,937	6.41							5,116,308	32,808,937
Ohio	15	1,963	12,959,480	71 64	9,284,194	48,491,596	5 22							9,284,194	48,491,596
Pennsylvania	12	3,322	22,850,457	68 41	15,632,354	66,163,689	4 23	14,410	9,196,363	64.06	5,891,118	31,572,276	5.36	21,523,472	97,735,965
Tennessee	1	44	154,723	71 94	111,310	824,146	7.40	246	66,035	59 19	39,083	294,579	7.54	150,393	1,118,725
Utah	1	56	397,125	59.58	236,607	(1)	(1)	814	20,106	50 95	10,244	(1)	(1)	246,851	(1)
Virginia								1,286	540,759	60.02	324,573	1,922,181	5.92	324,573	1,922,181
Washington								160							
West Virginia	5	424	2,872,087	69.07	1,983,619	6,192,305	3.12	934	421,491	62.09	261,688	1,434,518	5.48	2,245,307	7,626,823
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	514	2,878,456	75.47	2,172,484	15,821,177	7.28	14	3,424	59.99	2,054	(1)	(1)	2,174,538	(1)
Undistributed						31,205,154	6.49					664,717	7.19		47,691,048
Total: 1941	87	13,016	82,608,837	70.79	58,482,422	316,477,231	5.41	18,669	10,529,316	63.67	6,704,156	36,490,006	5 44	65,186,578	352,967,237
1940	89	12,734	76,582,780	70 53	54,014,309	260,356,566	4 82	15,150	4,802,996	63 66	3,057,825	13,475,844	4.41	57,072,134	273,832,410

(1) Included under "Undistributed."

TABLE 11.—*Byproduct and beehive coke produced in Pennsylvania in 1941, by districts*

[Number of plants and ovens includes those idle during the year; 14 plants were under construction or reconstruction in 1941]

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Byproduct:							
Eastern Pennsylvania [1]	4	705	3,681,564	71 21	2,621,582	$17,565,844	$6.70
Western Pennsylvania [2]	8	2,617	19,168,893	67.87	13,010,772	48,597,845	3.74
	12	3,322	22,850,457	68.41	15,632,354	66,163,689	4.23
Beehive:							
Allegheny Mountain and Allegheny Valley	2	242	92,699	61.98	57,452	341,839	5.95
Connellsville	50	8,597	4,631,345	64 86	3,003,692	16,111,440	5.36
Lower Connellsville	16	3,121	2,959,236	63 79	1,887,751	9,839,849	5.21
Upper Connellsville	7	1,134	412,293	63.42	261,458	1,502,656	5.75
Pittsburgh and other districts [3]	7	1,316	1,100,790	61.84	680,765	3,776,492	5.55
	82	14,410	9,196,363	64 06	5,891,118	31,572,276	5.36
Grand total	94	17,732	32,046,820	67.16	21,523,472	97,735,965	4 54

[1] Includes plants at Bethlehem, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Champion, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[3] Includes Bedford and parts of Indiana and Westmoreland Counties.

TABLE 12.—*Byproduct coke produced in Ohio in 1941, by districts*

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Canton, Cleveland, and Massillon	5	595	4,204,377	72.92	3,065,770	$17,133,163	$5.59
Youngstown	3	602	4,033,907	70 72	2,852,827	13,259,425	4 65
Other districts [1]	7	766	4,721,196	71 29	3,365,597	18,099,008	5.38
	15	1,963	12,959,480	71.64	9,284,194	48,491,596	5.22

[1] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

On December 31, 1941, 13,016 byproduct-coke ovens—an all-time peak—were in existence. During the year, 443 new ovens were completed and put into operation, and 158 ovens were abandoned. The total number on December 31, 1941, represented the ovens in existence at the end of 1940 plus the difference in new ovens completed and old ones abandoned, taking into consideration changes due to replacement and reclassification (footnotes 2 and 3, table 13).

During the year the Office of Production Management approved a number of new byproduct-coke plants required to supply blast-furnace coke for the expansion program of iron production. At the end of 1941, 181 new byproduct ovens, with an estimated annual capacity of 1,017,319 tons, were under construction. In general, there was enough coke during the year to take care of industrial requirements.

Impelled by the growing need for furnace coke in 1941, many beehive ovens that had been abandoned for several years were rehabilitated and restored to active operation. The average number of ovens

in operation—8,895 in December 1940—rose to 9,473 in January 1941. The number was increased in February and March but dropped in April to 3,212, owing to labor difficulties. Thereafter the monthly average of active ovens increased steadily for the remainder of the year and reached a peak of 12,321 in December, exceeding the December 1940 figure by 39 percent.

Table 13.—*Coke ovens completed and abandoned in the United States in 1941 and total number in existence at end of year, by States*

State	Plants in existence Dec. 31, 1941	Ovens: In existence Dec. 31, 1941: Number	Ovens: In existence Dec. 31, 1941: Annual capacity (net tons of coke)	Ovens: New: Number	Ovens: New: Annual capacity (net tons of coke)	Ovens: Abandoned during year	Ovens: Under construction Dec. 31, 1941: Number	Ovens: Under construction Dec. 31, 1941: Annual capacity (net tons of coke)
Byproduct:								
Alabama	8	1,352	5,790,315	98	547,500			
Colorado	1	188	645,300					
Connecticut	1	70	(1)	9	(1)			
Illinois	9	915	4,185,300			1		
Indiana	5	[2] 1,452	7,134,400	41	(1)	41		
Kentucky	1	120	(1)					
Maryland	1	422	2,124,000	61	396,000			
Massachusetts	2	215	1,165,880					
Michigan	8	660	3,132,168			87		
Minnesota	3	196	943,500					
Missouri	1	64	(1)					
New Jersey	2	[3] 239	1,032,000					
New York	8	1,054	5,571,563	76	384,000			
Ohio	15	1,963	9,313,900	101	(1)			
Pennsylvania	12	3,322	16,604,800			29	99	(1)
Rhode Island	1	65	(1)					
Tennessee	1	44	219,982	20	116,508			
Utah	1	56	238,710					
West Virginia	5	424	2,232,250	37	(1)		82	(1)
Wisconsin	2	195	(1)					
Undistributed			2,228,280		934,000			1,017,319
	87	13,016	62,562,348	443	2,378,008	158	181	1,017,319
At merchant plants	42	3,549	15,303,525	208	1,059,008	154	37	200,000
At furnace plants	45	9,467	47,258,823	235	1,319,000	4	144	817,319
Beehive:								
Alabama	4	545	233,012					
Colorado	1	260	(1)					
Kentucky	1	14	(1)					
Pennsylvania	82	14,410	9,248,265			278		
Tennessee	2	246	97,500					
Utah	1	814	(1)					
Virginia	8	1,286	684,774					
Washington	1	160	(1)					
West Virginia	9	934	370,100			8		
Undistributed			576,200					
	109	[4] 18,669	11,209,851			286		

[1] Included under "Undistributed."
[2] 1 old battery replaced by a new battery of 2 less ovens.
[3] 5 ovens heretofore included are for making pitch coke.
[4] Increase in number of ovens is due to number previously reported abandoned that were returned by operators to "in existence" list.

Table 14.—*Average number of beehive ovens active in the United States in 1941, by months*

Month	Number	Month	Number	Month	Number
January	9,473	May	11,125	September	11,781
February	10,186	June	11,277	October	11,942
March	10,846	July	11,450	November	12,080
April	3,212	August	11,537	December	12,321

TABLE 15.—*Byproduct ovens of each type in the United States at end of 1941, by States*

State	Koppers [1]	Semet-Solvay	Wilputte	Cambria	American Foundation	All others [2]	Total
Alabama	872	420	60				1,352
Colorado	188						188
Connecticut	70						70
Illinois	661	120	88			46	915
Indiana	932	120	400				1,452
Kentucky		120					120
Maryland	422						422
Massachusetts	160		55				215
Michigan	314	346					660
Minnesota	196						196
Missouri	56					8	64
New Jersey	239						239
New York	743	180	76		55		1,054
Ohio	1,594	369					1,963
Pennsylvania	3,014	88	97	120		3	3,322
Rhode Island	65						65
Tennessee		24	20				44
Utah	56						56
West Virginia	316		108				424
Wisconsin	115	80					195
	10,013	1,867	904	120	55	57	13,016
At merchant plants	1,993	1,141	303		55	57	3,549
At furnace plants	8,020	726	601	120			9,467

[1] Includes Koppers-Becker type.
[2] Includes 46 Curran-Knowles, 8 Piette, and 3 Disco ovens.

CAPACITY OF BYPRODUCT PLANTS

The relationship of production to maximum capacity of byproduct-coke plants in 1941 is shown in table 16. The maximum capacity of a byproduct plant is calculated by estimating the minimum coking time at which the ovens in that plant can be operated efficiently to produce coke suitable for the use for which it is intended. The theoretical maximum capacity seldom is attained in actual operation for various practical reasons that are governed by operating, economic, or labor conditions at the plant.

The efficiency attained by byproduct-coke plant operators in 1941 was the highest ever recorded in this country; production amounted to 92 percent of the maximum capacity of the ovens.

The maximum daily capacity of the 87 byproduct-coke plants in existence December 31, 1941, was 171,404 tons compared with 170,467 tons for 89 plants at the end of 1940. The daily capacity of the 42 merchant plants was 41,928 tons and that of the 45 furnace plants 129,476 tons.

TABLE 16.—*Relationship of production to potential maximum capacity [1] at byproduct-coke plants in the United States, 1929 and 1938-41, by months, in percent*

Month	1929	1938	1939	1940	1941	Month	1929	1938	1939	1940	1941
January	88.6	52.4	62.8	89.2	92.0	August	93.6	47.3	70.2	87.3	93.4
February	91.3	52.3	63.5	81.3	92.9	September	91.9	52.4	77.2	89.2	91.9
March	93.0	50.7	64.1	78.1	93.2	October	92.3	57.9	86.6	90.2	92.0
April	92.8	47.7	56.2	78.0	86.4	November	89.0	63.3	90.3	91.5	92.1
May	94.0	43.2	44.4	80.4	90.6	December	83.1	62.8	89.7	91.2	94.8
June	93.9	40.4	59.2	85.6	93.3						
July	93.0	41.3	64.4	86.1	93.7	The year	91.4	51.0	68.9	85.7	92.2

[1] Capacity of all ovens in existence, whether active or idle, based upon maximum daily capacity times days in month.

QUANTITY AND COST OF COAL CHARGED

The quantity of coal used for making coke in 1941 totaled 93,138,153 tons; this amount was the highest on record and exceeded that used in 1940 by 11,752,377 tons or 14 percent. Byproduct ovens consumed 82,608,837 tons of coal, an increase of 6,026,057 tons (8 percent); and beehive ovens used 10,529,316 tons, or 5,726,320 tons more than in 1940. Coal charged into coke ovens represented 18 percent of the total estimated production of bituminous coal for the year.

The cost of coking coal rose sharply in 1941. The average cost of coal charged into byproduct ovens was \$3.92 compared with \$3.68 in 1940, an increase of \$0.24 per ton. It is of interest to note that, although the cost of coking coal throughout the Nation increased, the cost per ton of coal charged into byproduct ovens in Pennsylvania declined from \$2.84 in 1940 to \$2.69 in 1941.

The cost per ton of coal charged into byproduct ovens is determined chiefly by the location of the coke plant with relation to its sources of coal—in other words by the cost of transportation. West Virginia, with an average cost of \$2.63 per ton, was the lowest in the country; Minnesota, with a cost of \$5.19 per ton, was the highest.

The average cost per ton of coal charged into beehive ovens was \$2.33 compared with \$3.92 for byproduct ovens, as beehive ovens generally are situated near the sources of coal. The yield of coke per ton of coal charged into beehive ovens is less than the yield from byproduct ovens. However, the lower cost per ton of coal charged into beehive ovens explains the lower cost of the quantity of coal required to produce 1 ton of coke—\$3.66 for beehive ovens compared with \$5.53 for byproduct ovens.

The cost per ton of the coal used in beehive ovens in 1941 ranged from \$1.94 in Virginia to \$3.64 in two Western States—Colorado and Utah.

TABLE 17.—*Coal consumed in coke ovens in the United States, 1939–41, by months, in net tons*

Month	1939			1940			1941		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January	4,785,200	127,400	4,912,600	6,648,600	390,700	7,039,300	7,021,300	860,000	7,881,300
February	4,377,200	116,800	4,494,000	5,671,400	254,700	5,926,100	6,408,900	830,600	7,239,500
March	4,890,000	113,200	5,003,200	5,824,900	221,600	6,046,500	7,116,400	979,800	8,096,200
April	4,143,400	32,700	4,176,100	5,627,800	167,800	5,795,600	6,367,800	155,600	6,523,400
May	3,407,500	40,900	3,448,400	5,995,000	173,900	6,168,900	6,832,500	894,100	7,726,600
June	4,392,300	85,400	4,477,700	6,179,500	252,100	6,431,600	6,816,700	931,900	7,748,600
July	4,782,900	76,300	4,859,200	6,608,300	385,700	6,994,000	7,067,100	955,400	8,022,500
August	5,214,200	72,700	5,286,900	6,697,900	464,500	7,162,400	7,067,700	1,008,700	8,076,400
September	5,556,700	123,900	5,680,600	6,619,200	454,300	7,073,500	6,775,400	948,300	7,723,700
October	6,446,900	421,200	6,868,100	6,922,500	606,400	7,528,900	7,010,200	1,012,400	8,022,600
November	6,503,500	570,500	7,074,000	6,793,800	657,700	7,451,500	6,814,600	878,600	7,693,200
December	6,716,100	516,800	7,232,900	6,993,900	773,600	7,767,500	7,310,300	1,073,900	8,384,200
	61,215,900	2,297,800	63,513,700	76,582,800	4,803,000	81,385,800	82,608,900	10,529,300	93,138,200

TABLE 18.—*Total quantity and value at ovens of coal used in manufacturing coke in the United States in 1941, by States*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average	Net tons	Cost
Byproduct plants:					
Alabama	6,656,387	$18,541,003	$2.79	1.40	$3.91
Colorado	956,279	(1)	(1)	1.54	(1)
Illinois	5,141,881	25,319,026	4.92	1.40	6.89
Indiana	10,103,930	52,172,332	5.16	1.36	7.02
Maryland	2,413,996	(1)	(1)	1.38	(1)
Massachusetts	1,651,177	(1)	(1)	1.42	(1)
Michigan	4,015,810	17,465,376	4.35	1.40	6.09
Minnesota	950,812	4,936,804	5.19	1.39	7.21
New Jersey	1,439,711	(1)	(1)	1.40	(1)
New York	7,166,526	34,894,188	4.87	1.40	6.82
Ohio	12,959,480	53,475,938	4.13	1.40	5.78
Pennsylvania	22,850,457	61,498,347	2.69	1.46	3.93
Tennessee	154,723	567,205	3.67	1.39	5.10
Utah	397,125	(1)	(1)	1.68	(1)
West Virginia	2,872,087	7,556,800	2.63	1.45	3.81
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,878,456	13,755,294	4.78	1.32	6.31
Undistributed		33,347,768	4.40		6.29
	82,608,837	323,530,081	3.92	1.41	5.53
At merchant plants	18,666,784	87,192,047	4.67	1.38	6.44
At furnace plants	63,942,053	236,338,034	3.70	1.42	5.25
Beehive plants:					
Alabama	156,940	388,512	2.48	1.65	4.09
Colorado and Utah	144,304	524,988	3.64	1.60	5.82
Kentucky and Tennessee	69,459	174,008	2.51	1.69	4.24
Pennsylvania	9,196,363	21,503,971	2.34	1.56	3.65
Virginia	540,759	1,048,667	1.94	1.67	3.24
West Virginia	421,491	901,816	2.14	1.61	3.45
	10,529,316	24,541,962	2.33	1.57	3.66

[1] Included under "Undistributed."

TABLE 19.—*Average cost per net ton of coal charged into byproduct-coke ovens in the United States, 1929 and 1938–41, by States*

State	1929	1938	1939	1940	1941	State	1929	1938	1939	1940	1941
Alabama	$2.49	$2.53	$2.39	$2.41	$2.79	Tennessee	$3.02	$3.34	$3.50	$3.46	$3.67
Illinois	4.29	4.59	4.55	4.57	4.92	Washington	5.26				
Indiana	4.61	4.90	4.68	4.72	5.16	West Virginia	2.41	2.46	2.33	2.39	2.63
Massachusetts	4.70	(1)	(1)	(1)	(1)						
Michigan	4.29	4.06	4.08	3.99	4.35	United States average	3.50	3.92	3.75	3.68	3.92
Minnesota	5.04	5.53	5.49	5.16	5.19						
New York	4.22	4.71	4.61	4.56	4.87	Cost of coal per ton of coke	5.04	5.61	5.36	5.23	5.53
Ohio	3.31	3.83	3.81	3.78	4.13						
Pennsylvania	2.73	3.20	2.93	2.84	2.69						

[1] Bureau of Mines not at liberty to publish data.

PREPARATION AND SOURCE OF COAL

The cleaning of coal to reduce its ash and sulfur content is of increasing importance to the coke industry in the United States. Many inferior coals require only washing to produce a good-quality metallurgical or domestic coke in coke ovens. Coke made from high-ash and high-sulfur coals causes definite economic losses in the blast furnace. If the coal charged into ovens is high in ash content, the coke produced has an even higher ash content, which is not desirable in industrial or domestic coke.

Of the coal consumed in byproduct ovens during 1941, all of that used in Colorado and Tennessee, 90 percent of that used in Alabama, and more than a third of that used in Pennsylvania was washed (table 20). Both pneumatic cleaning and wet washing methods are employed to prepare coal for use in coke ovens, depending on local conditions. Some coal is washed by producers at mines and some by coke-plant operators at plants. Of the total coal charged into byproduct ovens during 1941, 20,671,576 tons (25 percent) were washed. In the beehive-coke industry only 1,441,757 tons (14 percent of the total) were washed.

TABLE 20.—*Washed and unwashed coal used in manufacturing coke in the United States in 1941, by States in which used, in net tons*

State	Washed	Unwashed	Total
Byproduct plants:			
Alabama	5,963,603	692,784	6,656,387
Colorado	956,279		956,279
Illinois	308,831	4,833,050	5,141,881
Indiana		10,103,930	10,103,930
Maryland		2,413,996	2,413,996
Massachusetts		1,651,177	1,651,177
Michigan	218,981	3,796,829	4,015,810
Minnesota	70,937	879,875	950,812
New Jersey		1,439,711	1,439,711
New York	877,033	6,289,493	7,166,526
Ohio	2,810,861	10,148,619	12,959,480
Pennsylvania	8,300,936	14,549,521	22,850,457
Tennessee	154,723		154,723
Utah		397,125	397,125
West Virginia	982,279	1,889,808	2,872,087
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	27,113	2,851,343	2,878,456
	20,671,576	61,937,261	82,608,837
At merchant plants	1,756,311	16,910,473	18,666,784
At furnace plants	18,915,265	45,026,788	63,942,053
Beehive plants:			
Alabama	154,740	2,200	156,940
Colorado and Utah	124,198	20,106	144,304
Kentucky and Tennessee	66,035	3,424	69,459
Pennsylvania	1,096,784	8,099,579	9,196,363
Virginia		540,759	540,759
West Virginia		421,491	421,491
	1,441,757	9,087,559	10,529,316

Four States furnished most of the coal consumed in byproduct-coke plants. Pennsylvania, with 34,670,699 tons, led the Nation, followed by West Virginia, with 29,425,684 tons; Kentucky, with 9,271,279 tons; and Alabama, with 6 462,661 tons. Together these States supplied 96 percent of all coal used in byproduct ovens in 1941.

TABLE 21.—*Coal purchased for manufacture of byproduct coke in the United States in 1941, by fields of origin, in net tons*

[Based upon detailed reports from each coke plant. Difference between these totals and those shown in tables 1, 10, 17, etc., is due to change in stock, loss of weight in handling, and the fact that these represent purchases during the year rather than actual consumption]

State and district where coal was produced	Total purchased	States where coal was consumed—in order of importance
Alabama	6,462,661	Alabama.
Colorado	1,005,101	Colorado.
Georgia	19,659	Tennessee.
Illinois	236,251	Illinois.
Indiana	45,589	Do.
Kentucky, Eastern:		
Elkhorn (including Hazard)	2,467,411	Indiana, Ohio, Illinois, New York, Michigan, New Jersey, Minnesota, and Wisconsin.
Harlan	4,255,124	Indiana, Illinois, Minnesota, Ohio, Michigan, New York, and Wisconsin.
Kenova-Thacker	1,613,608	Michigan, Ohio, Wisconsin, and West Virginia.
Miscellaneous	935,136	Indiana, Ohio, and Illinois.
Maryland	170	Pennsylvania.
New Mexico	53,050	Colorado.
Pennsylvania:		
Central Pennsylvania:		
Medium-volatile	563,138	New York, Maryland, and Pennsylvania.
Low-volatile	2,480,013	Pennsylvania, Ohio, New York, Connecticut, and Minnesota.
Connellsville	16,306,546	Pennsylvania, Ohio, West Virginia, New York, Illinois, Minnesota, Michigan, New Jersey, and Connecticut.
Freeport	1,877,533	West Virginia, Ohio, Michigan, New York, and Pennsylvania.
Pittsburgh	11,867,295	Pennsylvania, New York, Ohio, Michigan, Illinois, Wisconsin, and Connecticut.
Somerset	552,272	Pennsylvania, West Virginia, New York, and Massachusetts.
Westmoreland	1,022,500	Pennsylvania, New York, Maryland, Minnesota, and Connecticut.
Miscellaneous	1,402	Pennsylvania.
Tennessee	166,263	Tennessee and Illinois.
Utah	397,125	Utah.
Virginia	1,433,771	Indiana, Michigan, New Jersey, New York, Pennsylvania, Ohio, Connecticut, and Illinois.
West Virginia:		
Coal and Coke	110,209	Pennsylvania.
Kanawha-Logan	8,994,964	Ohio, Massachusetts, Illinois, Indiana, West Virginia, Kentucky, Michigan, New Jersey, New York, Wisconsin, Pennsylvania, Connecticut, Rhode Island, Missouri, and Minnesota.
New River:		
High-volatile	738,963	New York, New Jersey, Massachusetts, and Connecticut.
Low-volatile (including Winding Gulf)	2,619,679	New Jersey, New York, Massachusetts, Michigan, Maryland, Missouri, Rhode Island, Illinois, Wisconsin, Connecticut, West Virginia, Minnesota, Kentucky, Ohio, and Pennsylvania.
Northern	4,272,101	Maryland, Pennsylvania, Ohio, Michigan, West Virginia, Illinois, and Minnesota.
Pocahontas (including Tug River)	12,259,354	Indiana, Ohio, Illinois, New York, Michigan, Maryland, Minnesota, Pennsylvania, Wisconsin, Kentucky, Connecticut, Alabama, and West Virginia.
Webster-Gauley	370,741	Pennsylvania, New York, and New Jersey.
Williamson	59,673	Ohio, Massachusetts, Pennsylvania, and Connecticut.
	83,187,302	

TABLE 22.—*Coal purchased for manufacture of byproduct coke in the United States in 1941, by States where produced and where consumed and by merchant and furnace plants, in net tons*

State where coal was consumed	Coal produced in—													
	Alabama	Colorado	Georgia	Illinois	Indiana	Kentucky	Maryland	New Mexico	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Alabama: Merchant plants	1,367,507												88,601	1,456,108
Furnace plants	5,095,154												8,902	5,104,056
Total Alabama	6,462,661												97,503	6,560,164
Colorado: Furnace plant		1,005,101						53,050						1,058,151
Illinois: Merchant plants				236,251		123,333			97,783			11,301	1,640,017	2,108,685
Furnace plants					45,589	1,295,594			280,657	14,224			1,418,714	3,054,778
Total Illinois				236,251	45,589	1,418,927			378,440	14,224		11,301	3,058,731	5,163,463
Indiana: Merchant plants													706,197	706,197
Furnace plants						4,151,761						663,061	4,540,256	9,355,078
Total Indiana						4,151,761						663,061	5,246,453	10,061,275
Maryland: Furnace plant									139,089				2,276,426	2,415,515
Massachussetts: Merchant plants									11,270				1,645,514	1,656,784
Michigan: Merchant plants						76,042			320,655			133,536	820,538	1,350,771
Furnace plants						1,326,727			195,253			271,166	974,307	2,767,453
Total Michigan						1,402,769			515,908			404,702	1,794,845	4,118,224
Minnesota: Merchant plants						61,793			85,064				238,266	385,123
Furnace plants						394,783			46,940				294,796	736,519
Total Minnesota						456,576			132,004				533,062	1,121,642
New Jersey: Merchant plants						95,235			12,922			139,488	1,178,572	1,426,217
New York: Merchant plants						271,126			1,954,141			107,614	1,652,834	3,985,715
Furnace plants									2,338,147			15,425	800,681	3,154,253
Total New York						271,126			4,292,288			123,039	2,453,515	7,139,968
Ohio: Merchant plants						13,653						30,694	819,961	864,308
Furnace plants						1,389,499			6,580,959			1,527	4,261,038	12,233,023
Total Ohio						1,403,152			6,580,959			32,221	5,080,999	13,097,331

TABLE 22.—*Coal purchased for manufacture of byproduct coke in the United States in 1941, by States where produced and where consumed and by merchant and furnace plants, in net tons*—Continued

State where coal was consumed	Coal produced in—													
	Alabama	Colorado	Georgia	Illinois	Indiana	Kentucky	Maryland	New Mexico	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Pennsylvania: Merchant plants									135, 744				647, 987	783, 731
Furnace plants							170		20, 486, 922			39, 421	1, 677, 928	22, 204, 441
Total Pennsylvania							170		20, 622, 666			39, 421	2, 325, 915	22. 988 172
Tennessee: Merchant plant			19, 659							152, 039				171, 698
Utah Furnace plant											397, 125			397, 125
West Virginia: Merchant plants									7, 663				943, 288	950. 951
Furnace plants						10, 143			1. 929, 012				107	1, 939, 262
Total West Virginia						10, 143			1, 936, 675				943, 395	2, 890, 213
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin Merchant plants						61, 590			48, 478			20, 538	2, 790, 754	2, 921, 360
	6, 462, 661	1, 005. 101	19, 659	236, 251	45, 589	9. 271, 279	170	53, 050	34, 670, 699	166, 263	397. 125	1, 433, 771	29, 425, 684	83, 187, 302
At merchant plants	1. 367, 507		19, 659	236, 251		702, 772			2, 673. 720	152. 039		443, 171	13, 172, 529	18, 767, 648
At furnace plants	5, 095. 154	1, 005, 101			45. 589	8, 568. 507	170	53, 050	31, 996. 979	14, 224	397, 125	990, 600	16, 253, 155	64, 419, 654

The examination and development of new sources of coking coal are important because of the irregular and limited distribution of high-grade coals of established coking quality. Owing to the rapid rate at which the reserves of such coals are being depleted, the blending of various types of coal is a conservational as well as an efficiency measure. The custom of mixing a variety of coking coals before charging into the ovens is primarily to produce economically coke of a quality satisfactory for the use for which it is intended. Some coals with many satisfactory coking qualities expand when coked, and their use alone would cause difficulty in discharging the coke from the oven and might even injure the byproduct-oven walls. For this reason, it is customary to mix such coals with others having a lower coefficient of expansion. This practice also permits the use of coals that have good coking qualities but have objectionable impurities, such as high content of ash, sulfur, and phosphorus. Such coals should not be used as a 100-percent charge in the ovens. Coal mixtures are commonly used at byproduct-coke plants, and this practice has resulted not only in the production of superior coke but also in the extensive utilization of coals, which, in unmixed condition, would not be suitable for coke manufacture.

Classification of all coal purchased for coking in byproduct ovens in 1941 from the data supplied by the operators showed that 53,875,666 tons (65 percent) were high-volatile coal containing over 32 percent volatile matter; 10,880,601 tons (13 percent), medium-volatile coal containing 23 to 31 percent volatile matter; and 18,431,035 tons (22 percent), low-volatile coal or coal containing 14 to 22 percent volatile matter.

TABLE 23.—*Coal purchased for manufacture of byproduct coke in the United States in 1941, by States where consumed and by volatile content* [1]

State where coal was consumed	Low-volatile		Medium-volatile		High-volatile		Total coal consumed (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
Alabama: Merchant plants	88,601	6.1	1,307,509	89.8	59,998	4.1	1,456,108
Furnace plants	8,902	.2	5,002,992	98 0	92,162	1.8	5,104,056
Total Alabama	97,503	1.5	6,310,501	96.2	152,160	2.3	6,560,164
Colorado: Furnace plant					1,058,151	100.0	1,058,151
Illinois. Merchant plants	580,621	27 5	967,635	45.9	560,429	26.6	2,108,685
Furnace plants	1,314,499	43 0			1,740,279	57.0	3,054,778
Total Illinois	1,895,120	36 7	967,635	18 7	2,300,708	44.6	5,163,463
Indiana: Merchant plants	315,864	44.7	390,333	55.3			706,197
Furnace plants	4,495,858	48.1			4,859,220	51.9	9,355,078
Total Indiana	4,811,722	47 8	390,333	3.9	4,859,220	48.3	10,061,275
Maryland: Furnace plant	562,083	23.3	139,089	5.7	1,714,343	71.0	2,415,515
Massachusetts: Merchant plants	424,712	25.6	328,091	19.8	903,981	54.6	1,656,784
Michigan: Merchant plants	449,782	33.3	313,507	23.2	587,482	43.5	1,350,771
Furnace plants	536,692	19.4	6,035	.2	2,224,726	80.4	2,767,453
Total Michigan	986,474	24.0	319,542	7.7	2,812,208	68.3	4,118,224
Minnesota: Merchant plants	78,292	20.3	21,483	5.6	285,348	74.1	385,123
Furnace plants	285,369	38.7	9,427	1.3	441,723	60.0	736,519
Total Minnesota	363,661	32.4	30,910	2.8	727,071	64.8	1,121,642

See footnote at end of table.

TABLE 23.—*Coal purchased for manufacture of byproduct coke in the United States in 1941, by States where consumed and by volatile content* [1]— Continued

State where coal was consumed	Low-volatile		Medium-volatile		High-volatile		Total coal consumed (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
New Jersey: Merchant plants	342,696	24.0			1,083,521	76.0	1,426,217
New York: Merchant plants	581,579	14.6	1,209,579	30.3	2,194,557	55.1	3,985,715
Furnace plants	946,537	30.0	357,529	11.3	1,850,187	58.7	3,154,253
Total New York	1,528,116	21.4	1,567,108	21.9	4,044,744	56.7	7,139,968
Ohio: Merchant plants	264,278	30.6			600,030	69.4	864,308
Furnace plants	3,321,661	27.1	218,334	1.8	8,693,028	71.1	12,233,023
Total Ohio	3,585,939	27.4	218,334	1.7	9,293,058	70.9	13,097,331
Pennsylvania: Merchant plants	174,052	22.2	218,674	27.9	391,005	49.9	783,731
Furnace plants	2,492,105	11.2	126,410	.6	19,585,926	88.2	22,204,441
Total Pennsylvania	2,666,157	11.6	345,084	1.5	19,976,931	86.9	22,988,172
Tennessee: Merchant plant	19,659	11.4	152,039	88.6			171,698
Utah: Furnace plant					397,125	100.0	397,125
West Virginia: Merchant plants	75,940	8.0	7,663	.8	867,348	91.2	950,951
Furnace plants	147,222	7.6			1,792,040	92.4	1,939,262
Total West Virginia	223,162	7.7	7,663	.3	2,659,388	92.0	2,890,213
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants	924,031	31.6	104,272	3.6	1,893,057	64.8	2,921,360
	18,431,035	22.1	10,880,601	13.1	53,875,666	64.8	83,187,302
At merchant plants	4,320,107	23.0	5,020,785	26.8	9,426,756	50.2	18,767,648
At furnace plants	14,110,928	21.9	5,859,816	9.1	44,448,910	69.0	64,419,654

[1] Low-volatile coals range from 14 to 22 percent volatile matter, medium-volatile, from 23 to 31 percent; and high-volatile, 32 percent and over.

YIELD OF COKE PER TON OF COAL

TABLE 24.—*Yield of coke from coal in byproduct and beehive ovens in the United States, 1938–41, by States, in percent*

State	1938		1939		1940		1941	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	70.93		71.01		71.03		71.51	60.66
Colorado	66.79	65.01	66.03	65.41	63.95	65.20	65.13	64.57
Illinois	67.05		68.12		70.56		71.20	
Indiana	70.32		70.26		73.24		73.31	
Maryland	72.14		72.88		72.33		72.60	
Massachusetts	70.42		70.72		71.11		70.36	
Michigan	69.17		69.34		70.06		71.31	
Minnesota	70.19		69.92		70.50		72.13	
New Jersey	71.84		71.05		71.67		71.65	
New York	71.14		71.16		71.34		71.39	
Ohio	71.02		71.09		71.48		71.64	
Pennsylvania	68.46	63.00	68.71	63.42	68.43	63.80	68.41	64.06
Tennessee	68.70	55.00	73.00		70.51	59.55	71.94	59.19
Utah	58.08	48.94	58.38	60.27	59.31	50.89	59.58	50.95
Virginia		57.04		56.87		59.97		60.02
Washington						60.20		
West Virginia	68.02	61.40	68.12	67.04	69.05	65.79	69.07	62.09
United States average	69.94	61.58	70.05	62.86	70.53	63.66	70.79	63.67

SOURCES OF COKING COALS [1]

The increased emphasis placed upon the coke industry by the war program has created widespread interest in coke production. An adequate supply of suitable coal is the prime requisite of the coke industry, and the urgent demand for metallurgical coke by the iron

[1] Prepared by J. R. Bradley, Coal Economics Division, Bureau of Mines.

and steel industry has greatly augmented the need for coking coal. The following table shows the sources of production of coking coals by States, counties, and beds. Four Eastern States (Pennsylvania, West Virginia, Kentucky, and Alabama) mined 93 percent of the output, and only a small percentage of coking coal is mined west of the Mississippi River. Production in 1940 by mines that shipped coal to coke plants in 1941 totaled 171,440,000 tons, of which Pennsylvania's Connellsville region contributed 25 percent, Pennsylvania outside of the Connellsville region 13 percent, West Virginia 40 percent, Kentucky 10 percent, and Alabama 5 percent. The principal producing counties in West Virginia were McDowell, Raleigh, Fayette, and Marion, which supplied 35, 20, 12, and 11 percent, respectively. The Pocahontas bed produced 48 percent of the State total, Pittsburgh bed 11 percent, Eagle bed 8 percent, and all other beds 33 percent. In Pennsylvania the Connellsville region produced 42,473,000 tons, of which that supplied by Fayette County represented 47 percent, Washington County 24 percent, and Westmoreland and Greene Counties about 11 percent each; of the Connelsville total the Pittsburgh bed supplied 89 percent and the Freeport bed 8 percent. Pennsylvania outside of the Connellsville region produced 21,741,000 tons, of which Allegheny County supplied 42 percent and Cambria County 41 percent; the principal beds from which the coal was produced were the Kittanning (33 percent), Freeport (29 percent), and Pittsburgh (17 percent).

Of the 17,371,000 tons of coal produced in Kentucky, Harlan County supplied 49 percent, and Floyd, Letcher, and Pike Counties 18, 16, and 13 percent, respectively. The principal beds mined were the Elkhorn, with 35 percent of the State total, Kellioka 23 percent, and Harlan 19 percent. In 1940 Alabama produced 9,283,000 tons, of which Jefferson County supplied 88 percent. The principal beds mined were the Pratt, which supplied 44 percent, and the Mary Lee, 42 percent.

TABLE 25.—*Production of coking coal in 1940, by States, counties, and beds, from mines shipping to coke ovens in 1941*

State and county	Production (thousand net tons)	Bed: Name	Bed: Percent of State total
Alabama:			
Jefferson	8,173	Pratt	44
Walker	560	Mary Lee	42
Bibb	293	All others	14
Shelby	257		
	9,283		100
Colorado:			
Las Animas	1,061	Raton	44
Gunnison	214	Vermejo	28
Huerfano	176	Mesa Verde	14
Fremont	62	All others	14
	1,513		100
Georgia: Walker	37	Unknown	100
Illinois:			
Franklin	612	No. 6	55
St. Clair	496	St. Clair	45
	1,108		100
Indiana: Spencer	77	Brazil Block	100

Table 25.—*Production of coking coal in 1940, by States, counties, and beds, from mines shipping to coke ovens in 1941*—Continued

State and county	Production (thousand net tons)	Bed: Name	Bed: Percent of State total
Kentucky:			
Harlan	8,510	Elkhorn	35
Floyd	3,166	Kellioka	23
Letcher	2,866	Harlan	19
Pike	2,278	Freeburn	13
Bell	502	All others	10
Jackson	49		
	17,371		100
Maryland: Allegany	65	Pittsburgh	100
New Mexico: Colfax	308	Raton	100
Pennsylvania:			
Connellsville:			
Fayette	19,797	Pittsburgh	59
Washington	10,225	Freeport	5
Westmoreland	4,655	All others	2
Greene	4,503		
Indiana	3,293		
	42,473		66
Outside Connellsville:			
Allegheny	9,198	Kittanning	11
Cambria	8,872	Freeport	9
Somerset	3,646	Pittsburgh	6
Bedford	25	Miller	3
		All others	5
	21,741		34
Tennessee.			
Marion	460	Sewanee	91
Rhea	37	All others	9
Grundy	35		
Morgan	4		
Cumberland	3		
White	2		
	541		100
Utah:			
Carbon	483	Castle Gate	76
		Mesa Verde	19
		All others	5
	483		100
Virginia:			
Tazewell	2,848	Pocahontas	29
Buchanan	2,575	Taggart	18
Wise	1,898	Splashdam	14
Russell	490	Jewel	13
Lee	215	Clintwood	12
		Upper Banner	6
		All others	8
	8,026		100
West Virginia:			
McDowell	24,127	Pocahontas	48
Raleigh	13,895	Pittsburgh	11
Fayette	8,322	Eagle	8
Marion	7,628	Sewell	8
Logan	4,024	War Creek	6
Mercer	3,228	Powellton	5
Wyoming	2,085	All others	14
Kanawha	1,658		
Boone	1,286		
Webster	888		
Monongalia	598		
Greenbrier	215		
Preston	158		
Randolph	158		
Mingo	101		
Harrison	32		
Upshur	12		
	68,415		100
Total United States	171,441		

COKE BREEZE

TABLE 26.—*Coke breeze recovered at coke plants in the United States in 1941, by States*

State	Yield per ton of coal (percent) [1]	Produced		Used by producer				Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
				For steam raising		For other purposes, including water gas					
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Byproduct ovens:											
Alabama	4. 68	311, 772	$679, 841	182, 032	$306, 825	27, 968	$59, 768	156, 005	$434, 240		17, 290
Colorado	7. 38	70, 552	(2)	30, 628	(2)			54, 922	(2)		161
Illinois	6. 34	326, 085	782, 171	162, 763	437, 508	28, 209	61, 001	113, 592	237. 435		74, 712
Indiana	4 24	428, 905	876, 028	321, 608	642, 175	69. 957	149. 239	65, 289	132, 968		24, 139
Maryland	7 40	178, 701	(2)	124, 103	(2)	30, 401	(2)				85, 168
Massachusetts	6. 62	109. 378	(2)	83. 431	(2)	8, 116	(2)	16, 763	(2)		5, 646
Michigan	4 84	194. 337	918, 967	149, 357	722, 433	17, 269	53. 431	21, 655	91, 029		4, 025
Minnesota	5 08	48, 319	150, 651	21, 111	59, 213	6, 173	12, 346	23, 869	88, 400		11, 844
New Jersey	5 82	83. 726	(2)	84, 651	(2)	7	(2)	1, 093	(2)		1, 718
New York	4. 55	325. 833	980. 852	239, 476	666, 311	48, 668	149, 519	87, 257	301, 766		52, 207
Ohio	5. 18	671, 498	1, 335, 562	481, 054	968, 950	120, 945	240. 374	90, 335	154. 284	2, 505	91, 757
Pennsylvania	6. 12	1, 392, 269	2, 288, 268	1, 228, 381	2, 019, 334	47, 421	55, 906	123, 728	233, 577		53. 310
Tennessee	4. 88	7, 551	38, 510					9, 436	48, 124		428
Utah	5. 22	20, 723	(2)	2, 489	(2)	5, 403	(2)	20, 997	(2)		1, 711
West Virginia	5. 20	115. 632	184, 941	92, 037	131, 094	17, 521	23, 829	21, 606	57, 007		8, 531
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5. 13	147, 583	439. 473	132. 584	379, 851			29, 612	104, 552		10, 719
Undistributed			855, 169		628, 317		76, 733		131, 178		
Total byproduct, 1941	5. 41	4, 432, 864	9. 530, 433	3, 335, 705	6. 962, 011	428, 058	882, 146	836, 159	2, 014, 560	2, 505	443, 366
At merchant plants	5 57	998. 687	2. 765, 049	692, 374	1, 848, 587	51, 253	148. 781	307, 500	938, 097	2. 505	136, 631
At furnace plants	5. 37	3, 434, 177	6, 765, 384	2, 643, 331	5, 113, 424	376, 805	733, 365	528, 659	1, 076, 463		306, 735
Total byproduct, 1940	5 37	4, 078, 037	8, 472, 114	3. 013, 070	6, 139, 014	465, 871	958. 183	603. 657	1, 377, 970	17, 008	419, 867
Beehive ovens:											
Alabama	5. 08	7, 592	15. 630	7, 592	15, 630						
Colorado and Utah	3 40	4, 911	4, 616					4, 911	4, 616		
Kentucky and Tennessee	2 75	94	447					90	428	4	
Pennsylvania	2. 57	103, 287	102, 085	28, 333	36, 765	624	618	26, 993	23, 481	47, 066	1, 388
Virginia	. 17	563	2, 655			136	670	427	1, 985		20
West Virginia	1. 47	5, 202	6, 137			20	20	542	648	4, 600	40
Total beehive, 1941	2. 43	121, 649	131, 570	35, 925	52, 395	780	1, 308	32, 963	31, 158	[3] 51, 670	1, 448

[1] Yield computed by dividing production of breeze by coal charged at plants actually recovering.
[2] Included under "Undistributed."
[3] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources of the United States, 1922, part 2, pp. 726-727.

CONSUMPTION OF COKE

Records of the consumption of coke are important because of the light that they throw on the trend of demand and hence on the prospects for future expansion of the industry. The calculated consumption of coke in 1941, making allowance for imports and exports from January through September only and changes in producers' stocks, was 65,101,401 tons. In comparison with 1940, the year showed an increase of 8,075,155 tons.

The principal use of coke in 1941 was in blast furnaces, where it is one of the basic materials employed for smelting iron ore. Unprecedented activity in the iron and steel industry in 1941 was due to the demand for steel to build war equipment. According to figures compiled by the American Iron and Steel Institute, 49,469,972 tons of coke (approximately 76 percent of the total coke consumption) went into blast furnaces for the manufacture of pig iron and ferro-alloys. The remainder—24 percent—was used in foundries, in smelting the nonferrous metals, in the manufacture of water gas, in miscellaneous other industrial uses, and in domestic heating.

Improvements in blast-furnace fuel efficiency and in the quality of the coke have resulted in a decline in coke requirements per net ton of pig iron produced (table 28). In 1913 blast furnaces required 2,172.6 pounds of coke per ton of pig iron; this has decreased until an all-time low of 1,767.8 pounds of coke per ton of pig iron and ferro-alloys was established in 1941.

TABLE 27.—*Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, and 1938–41, in net tons*

Year	Total production	Imports	Exports	Net change in stocks	Indicated United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Percent	Quantity	Percent
1913	46,299,530	101,212	987,395	(3)	45,413,347	37,192,287	81 9	8,221,060	18.1
1918	56,478,372	30,168	1,687,824	(3)	54,820,716	45,703,594	83.4	9,117,122	16.6
1938	32,495,815	135,240	486,571	+1,081,267	31,063,217	19,035,270	61 3	12,027,947	38 7
1939	44,326,641	141,911	589,925	—1,074,455	44,953,082	31,422,272	69 9	13,530,810	30 1
1940	57,072,134	112,550	804,095	—645,657	57,026,246	41,839,039	73 4	15,187,207	26.6
1941	65,186,578	[4] 241,690	[4] 525,223	—198,356	[5] 65,101,401	49,469,972	76.0	15,631,429	24 0

[1] Production plus imports minus exports, plus or minus decrease or increase, respectively, of net changes in stocks.
[2] From Report of American Iron and Steel Institute Figures include coke consumed in manufacture of ferro-alloys.
[3] Data not available.
[4] Figures cover January to September, inclusive.
[5] Subject to revision. Includes net difference between imports and exports for first 9 months only.

TABLE 28.—*Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, and 1938–41*

Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)	Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)
1913	2,172.6	66 9	3,247 5	1939	1,778 0	69 8	2,547.3
1918	2,120.7	66 4	3,193.8	1940	1,781.2	70 1	2,540.9
1938	1,801 0	69.7	2,583.9	1941	1,767.8	70.0	2,525.4

[1] From Report of American Iron and Steel Institute; consumption per ton of pig iron only, excluding furnaces making ferro-alloys, was 2,172.6 in 1913, 2,120.7 in 1918, 1,774.6 in 1938, 1,760.0 in 1939, 1,756.9 in 1940, and 1,745.2 in 1941.

FURNACE, FOUNDRY, DOMESTIC, AND OTHER COKE

The trade terms "furnace coke" and "foundry coke" refer to the size and grade, as well as to the use for which the coke may be intended. The requirements for good furnace coke and good foundry coke differ in some respects. Uniformity is vital to successful and economical blast-furnace operation. Furnace coke preferably should be uniform in size and in ash, sulfur, and phosphorus content; it usually is run-of-oven minus the small coke and breeze.

Foundry coke is somewhat different from furnace, as its only function in the cupola is to furnish heat to melt the iron, whereas in the blast furnace the function is twofold—to supply carbon monoxide for reduction and heat to melt the iron. The requirements of good foundry coke are minimum reactivity with carbon dioxide gas, larger size than blast-furnace coke (over 2½ to 3 inches), hardness and strength sufficient to prevent excessive degradation by impact of the massive iron charged into the cupola shaft, and relative freedom from impurities.

The most important characteristics of domestic coke are the ash content, fusing temperature of the ash, and density. Domestic coke may be screened from furnace or foundry coke, or it can be obtained by crushing the larger sizes. Special purposes may require other sizes and grades of coke. Not all furnace coke is used in blast furnaces or all foundry coke in foundries; and either grade may be purchased by other classes of consumers.

Coke as a domestic fuel is used chiefly in regions where there is a surplus of metallurgical coke or where there is a large production of city gas and corresponding large quantities of coke that must find a market. In the latter case, gas is the primary product and coke a byproduct in contrast to furnace and merchant plants, where coke is the primary product and gas a byproduct. Most of the coking plants are equipped to screen and size coke for domestic use.

In 1941 the sales of all kinds of coke except that for domestic use increased substantially. The demand for metallurgical fuel caused diversion of coke from domestic use to the metallurgical industry. Byproduct coke sold for furnace use, including coke sold to financially affiliated corporations, totaled 6,215,601 tons—21 percent more than in 1940. Foundries purchased 2,494,393 tons, a 34-percent increase over 1940. The increase in coke for metallurgical use resulted in a 19-percent decrease from 1940 in sales of domestic coke. The sales of byproduct coke for domestic use totaled 6,596,969 tons compared with 8,131,947 tons in 1940. Sales of industrial coke in 1941, including that used for the manufacture of water gas, amounted to 1,844,126 tons, an increase of 5 percent.

Sales of beehive coke in 1941 increased in proportion to the large increase in production. Coke sold by producers for blast-furnace use amounted to 4,805,099 tons compared with 1,799,292 tons in 1940, an increase of 167 percent. Most of the beehive coke is used in blast furnaces. Sales for foundry use increased 52 percent and those for industrial and other uses (including water gas) 46 percent. Beehive coke sold for domestic use declined from 99,066 tons in 1940 to 85,990 tons in 1941, or 13 percent.

TABLE 29.—*Byproduct coke produced and sold or used by producer in the United States in 1941, by States*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnaces [1]		Sold									
					Furnace [2]		Foundry		Domestic use		Industrial and other use (including water gas) [3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	4,759,862	$18,026,799	3,539,199	$11,575,812	543,587	$2,192,630	363,410	$2,872,950	112,373	$471,187	168,547	$834,981	1,187,917	$6,371,748
Colorado	622,867	(4)	567,186	(4)			8,829	(4)	1,603	(4)	43,063	(4)	53,495	(4)
Illinois	3,660,878	25,214,769	2,584,916	16,722,786	8,160	40,080	354,340	3,811,073	733,962	4,908,462	93,377	677,412	1,189,839	9,437,027
Indiana	7,406,724	48,432,824	6,694,535	42,829,283	(4)	(4)	(4)	(4)	191,699	1,093,758	67,110	393,529	722,241	5,673,477
Maryland	1,752,538	(4)	1,678,799	(4)					23,502	(4)	45,611	(4)	69,113	(4)
Massachusetts	1,161,732	(4)	168,257	(4)	9,955	(4)	84,275	(4)	897,532	(4)	45,509	(4)	1,037,271	(4)
Michigan	2,863,563	18,213,048	1,235,545	7,073,265	(4)	(4)	(4)	(4)	773,271	4,501,890	53,001	380,733	1,635,436	11,165,308
Minnesota	685,873	5,082,787	289,911	1,747,885	(4)	(4)	(4)	(4)	302,755	2,620,697	(4)	(4)	447,338	3,710,765
New Jersey	1,031,569	(4)	235,673	(4)	23,353	(4)	57,186	(4)	460,334	(4)	256,752	(4)	797,625	(4)
New York	5,116,308	32,808,937	1,903,456	12,060,560	1,758,964	10,455,112			1,236,484	8,781,055	221,013	1,562,979	3,216,461	20,799,146
Ohio	9,284,194	48,491,596	7,407,632	37,616,236	1,110,796	6,059,839	254,208	1,947,180	356,442	1,870,681	126,751	818,934	1,848,197	10,696,634
Pennsylvania	15,632,354	66,163,689	13,114,906	51,996,911	1,498,875	6,641,376	275,194	2,804,193	528,335	3,346,324	219,496	1,526,239	2,521,900	14,318,132
Tennessee	111,310	824,146	31,424	219,968			34,147	307,323	144	922	45,595	295,933	79,886	604,178
Utah	236,607	(4)	171,315	(4)	169	(4)			2,553	(4)	60,690	(4)	63,412	(4)
West Virginia	1,983,619	6,192,305	1,743,234	4,766,308	(4)	(4)	(4)	(4)	15,402	66,329	(4)	(4)	208,724	1,361,028
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,172,484	15,821,177	164,410	1,082,339	499,140	2,469,860	284,655	3,078,551	960,578	7,352,352	327,861	2,338,439	2,072,234	15,239,202
Undistributed		31,205,154		15,777,614	762,602	4,679,266	778,149	9,521,239		10,897,003	69,750	3,490,622		15,724,488
Grand total, 1941	58,482,422	316,477,231	41,530,398	203,468,967	6,215,601	32,538,163	2,494,393	24,342,509	6,596,969	45,910,660	1,844,126	12,309,801	17,151,089	115,101,133
At merchant plants	13,494,509	96,343,846	2,490,547	14,358,030	2,397,658	13,873,958	2,071,736	20,896,123	5,453,076	39,792,308	1,413,184	9,951,410	11,335,654	84,513,799
At furnace plants	44,987,913	220,133,385	39,039,851	189,110,937	3,817,943	18,664,205	422,657	3,446,386	1,143,893	6,118,352	430,942	2,358,391	5,815,435	30,587,334
Grand total, 1940	54,014,309	260,356,566	37,865,240	166,130,455	5,134,395	23,720,459	1,858,664	16,116,048	8,131,947	49,014,276	1,754,917	10,281,498	16,879,923	99,132,281

[1] Includes 772,720 net tons valued at $4,562,760 used to make producer gas; 1,174,279 tons, $6,142,787, used to make water gas; and 445,878 tons, $2,431,872, used for other purposes than in blast furnaces.

[2] Includes 3,690,730 net tons valued at $18,009,551 sold to financially affiliated corporations for blast furnace use; 707,118 tons, $4,161,299, sold for other purposes; and 1,817,753 tons, $10,367,313, reported as merchant sales.

[3] Includes 542,073 net tons valued at $3,827,345 sold for manufacture of water gas.

[4] Included under "Undistributed."

TABLE 30.—*Beehive coke produced and sold or used by producer in the United States in 1941, by States*

State	Produced		Used by producer in blast furnaces [1]		Sold	
					Furnace [2]	
	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	95,200	$601,735	(4)	(4)	(4)	(4)
Colorado and Utah	90,440	652,430	(4)	(4)		
Kentucky and Tennessee	41,137	306,866	(4)	(4)	(4)	(4)
Pennsylvania	5,891,118	31,572,276	830,308	$3,694,915	4,471,309	$24,520,230
Virginia	324,573	1,922,181			158,097	937,791
West Virginia	261,688	1,434,518	(4)	(4)	162,918	744,499
Undistributed			185,444	1,282,852	12,775	77,756
Total: 1941	6,704,156	36,490,006	1,015,752	4,977,767	4,805,099	26,280,276
1940	3,057,825	13,475,844	672,371	3,206,770	1,799,292	7,736,480

State	Sold—Continued							
	Foundry		Domestic use		Industrial and other use (including water gas) [3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama							(4)	(4)
Colorado and Utah	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Kentucky and Tennessee	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Pennsylvania	230,942	$1,453,656	79,559	$395,339	275,930	$1,482,250	5,057,740	$27,851,475
Virginia	57,815	365,316	4,290	20,072	104,765	614,169	324,967	1,937,348
West Virginia	44,091	333,401	1,525	6,235	51,630	341,385	260,164	1,425,520
Undistributed	19,218	131,257	616	3,090	1,147	7,815	33,756	219,918
Total: 1941	352,066	2,283,630	85,990	424,736	433,472	2,445,619	5,676,627	31,434,261
1940	231,298	1,182,808	99,066	385,365	297,520	1,230,954	2,427,176	10,535,607

[1] Includes 4,028 net tons valued at $20,145 used for other purposes than in blast furnaces.
[2] Includes 962,586 net tons valued at $4,759,191 sold to financially affiliated corporations for blast-furnace use; 8,502 tons, $42,107, sold for other purposes; and 3,834,011 tons, $21,478,978, reported as merchant sales.
[3] Includes 85,926 net tons valued at $405,080 sold for manufacture of water gas.
[4] Included under "Undistributed."

CONSUMPTION OF FOUNDRY COKE IN 1941

The important position of the foundry industry in the economic picture of the country is understood when it is pointed out that every one of the 3,000 foundries had to buy metals (mainly pig iron and ferrous scrap), coke, and sand. There resulted a large freight movement which utilized probably every railroad and waterway in the Nation to transport raw materials going into the foundry and castings coming out.

Coke is a basic fuel material in the cupolas and furnaces of the foundries, and coke must have suitable characteristics to meet the fuel requirements.

The American Society for Testing Materials has adopted the following specification limits [2] for the composition of foundry coke:

	Percentage in dried sample
Volatile matter	(not over) 2.0 percent
Fixed carbon	(not over) 86.0 percent
Ash	(not over) 12.0 percent
Sulfur	(not over) 1.0 percent

[2] American Society for Testing Materials, Specification D-17-16 for Foundry Coke: A. S. T. M. Standards for 1939, part III, Nonmetallic Materials, pp. 59-61.

Foundry coke must be of the highest quality; it therefore commands a premium over other grades of coke. The chemical and physical characteristics of coal-tar-pitch coke and petroleum coke make them unsuitable for foundry use. The only coke suitable for such use is that produced in byproduct or beehive ovens.

The national consumption of foundry coke in 1941 totaled 2,679,581 tons.

Widespread use of foundry coke is indicated by the fact that all States except Wyoming reported coke consumed for this purpose in 1941. Figures showing the consumption of foundry coke, by States, in 1941 reveal that Michigan consumed the largest amount—423,167 net tons. Pennsylvania was second with 321, 892 tons, Ohio third with 321,693 tons, and Illinois fourth with 225,253 tons. These four States consumed a total of 1,292,005 tons, or 48 percent of the entire consumption of the country. Substantial tonnages of foundry coke, aggregating 737,206 tons, or about 28 percent of the total, were consumed in Alabama, New York, Indiana, New Jersey, and Wisconsin.

The comparative consumption of foundry coke, by regions, is shown in table 31. From this table it will be noted that the Midwest region was far ahead in foundry-coke consumption during the year. The seven States composing this region used 1,312,423 tons, or 49 percent of the total of 2,679,581 tons. The Central Atlantic region was next, with a consumption of 715,576 tons, representing 27 percent of the total. All other regions consumed the remainder of the tonnage, or about 24 percent.

According to the figures submitted by the operators, stocks of foundry coke amounted to 302,795 tons at the end of the year, and they estimated that coke requirements for foundry purposes in 1942 would reach 2,877,134 tons.

TABLE 31.—*Consumption of foundry coke in the United States in 1941, by regions, in net tons*

Region	Foundry coke consumed		Stocks of foundry coke, Dec. 31, 1941	Estimated consumption of foundry coke during 1942
	Byproduct	Beehive		
New England:				
Maine	5,071	905	819	6,481
Connecticut	52,094	1,870	5,096	67,180
Massachusetts	54,456	3,741	6,980	67,104
New Hampshire	5,356	400	589	6,649
Rhode Island	14,558		754	16,912
Vermont	6,973	25	1,271	8,818
	138,508	6,941	15,509	173,144
Central Atlantic:				
New York	147,598	11,132	23,362	182,855
New Jersey	126,461	9,501	15,034	149,785
Delaware	3,687	685	587	5,702
Maryland	18,151	13,421	4,337	36,390
Pennsylvania	220,830	101,062	38,197	368,222
Virginia	27,479	22,798	5,615	55,338
West Virginia	5,675	6,812	837	14,574
District of Columbia		284	70	300
	549,881	165,695	88,039	813,166
Southeast:				
Mississippi	794	70	201	964
Alabama	170,142	845	14,066	179,147
Georgia	15,172	2,552	3,250	18,274
Florida	1,702	138	342	2,186
South Carolina	3,695	20,519	717	26,975
North Carolina	8,350	4,256	1,275	13,169
Tennessee	64,128	7,103	7,425	76,590
	263,983	35,483	27,276	317,305

TABLE 31.—*Consumption of foundry coke in the United States in 1941, by regions, in net tons*—Continued

Region	Foundry coke consumed		Stocks of foundry coke, Dec. 31, 1941	Estimated consumption of foundry coke during 1942
	Byproduct	Beehive		
Midwest:				
Ohio	305,329	16,364	39,031	349,951
Michigan	409,454	13,713	22,992	361,978
Wisconsin	118,326	5,146	16,021	141,238
Indiana	145,375	2,680	15,242	150,633
Iowa	47,827	3,480	6,790	50,269
Illinois	220,990	4,263	33,124	249,937
Kentucky	7,846	11,630	3,694	21,560
	1,255,147	57,276	136,894	1,325,566
West Mid-Continent:				
Colorado	10,388	546	1,997	15,049
Kansas	10,213	40	1,683	12,827
Nebraska	2,975	126	324	3,159
	23,576	712	4,004	31,035
Gulf Southwest:				
Louisiana	2,626	171	337	3,616
Texas	19,134	3,337	3,537	26,921
Arkansas	374	73	105	533
Missouri	47,900	568	4,821	55,828
Oklahoma	2,262	188	432	3,168
	72,296	4,337	9,232	90,066
Central Northwest.				
Minnesota	23,951	555	2,865	30,268
Montana	2,727		526	3,174
North Dakota		96	41	120
South Dakota	279		94	285
	26,957	651	3,526	33,847
Pacific Northwest:				
Idaho	78	452	247	621
Washington	6,576	2,714	2,651	11,373
Oregon	3,955	1,306	1,151	7,132
	10,609	4,472	4,049	19,126
Pacific Southwest:				
Arizona	4,655		98	4,905
New Mexico	186		7	210
Nevada	59	9	13	104
California	43,991	4,592	12,606	58,279
Utah	9,037	528	1,542	10,381
	57,928	5,129	14,266	73,879
Grand total	2,398,885	280,696	302,795	2,877,134

STOCKS OF COKE AND COKING COAL

Stocks of coke are governed by the demand from industry. The abnormal demand for coke in 1941 resulted in a decrease in stocks held by the producers at the end of 1941. Total stocks of coke at the end of the year were 198,356 tons less than at the beginning. Byproduct coke declined 11 percent below the stocks at the beginning of the year and totaled 1,709,391 tons (table 33). The stocks of coke held at beehive plants, which are relatively small, increased during the year to 48,695 tons compared with 43,308 tons at the end of 1940.

The stocks of bituminous coal at byproduct ovens in 1941 closely followed the trend of monthly coke production. They were largest at the end of February and smallest at the end of May. Beginning

with June, stocks increased each month (except November) until the end of December, when they amounted to 8,901,462 tons.

TABLE 32.—*Stocks of furnace, foundry, and domestic coke and of breeze in the United States on January 1, 1942, by States, in net tons*

State	Coke				Breeze
	Furnace	Foundry	Domestic and other	Total	
Byproduct plants:					
Alabama	162,800	1,700	10,687	175,187	17,290
Colorado	4,478	136		4,614	161
Illinois	13,085	3,695	108,738	125,518	74,712
Indiana	10,585	831	22,352	33,768	24,139
Maryland	50,040			50,040	85,168
Massachusetts	430	304	141,756	142,490	5,646
Michigan	3,233	5,529	34,872	43,634	4,025
Minnesota	882	1,074	100,448	102,404	11,844
New Jersey		128	59,709	59,837	1,718
New York	10,072		211,105	221,177	52,207
Ohio	181,174	618	41,756	223,548	91,757
Pennsylvania	188,383	1,931	89,109	279,423	53,310
Tennessee	22,783	105	47	22,935	428
Utah	2,125		5,071	7,196	1,711
West Virginia	47,480	373	5,968	53,821	8,531
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	348	4,024	159,427	163,799	10,719
	697,898	20,448	991,045	1,709,391	443,366
At merchant plants	30,371	17,633	836,124	884,128	136,631
At furnace plants	667,527	2,815	154,921	825,263	306,735
Beehive plants:					
Alabama	3,545			3,545	
Colorado and Utah	85	844		929	234
Kentucky and Tennessee	4,104	410		4,514	
Pennsylvania	8,347	1,463	21,535	31,345	1,388
Virginia	2,074	475	58	2,607	20
West Virginia	2,156	1,795	1,804	5,755	40
	20,311	4,987	23,397	48,695	1,682

TABLE 33.—*Summary of total stocks of coke on hand at all byproduct and beehive plants in the United States on January 1, 1929 and 1938–42, in net tons*

[Exclusive of screenings or breeze]

	1929	1938	1939	1940	1941	1942
Byproduct plants:						
Furnace	750,318	610,840	931,644	597,550	525,798	697,898
Foundry	24,426	29,828	88,334	49,771	14,123	20,448
Domestic and other	1,018,205	1,878,652	2,611,645	1,922,369	1,373,213	991,045
	1,792,949	2,519,320	3,631,623	2,569,690	1,913,134	1,709,391
Beehive plants:						
Furnace	38,446	13,542	7,228	16,402	16,022	20,311
Foundry	8,020	13,264	8,336	8,312	3,973	4,987
Domestic and other	8,511	49,161	29,367	7,695	23,313	23,397
	54,977	75,967	44,931	32,409	43,308	48,695
Total:						
Furnace	788,764	624,382	938,872	613,952	541,820	718,209
Foundry	32,446	43,092	96,670	58,083	18,096	25,435
Domestic and other	1,026,716	1,927,813	2,641,012	1,930,064	1,396,526	1,014,442
	1,847,926	2,595,287	3,676,554	2,602,099	1,956,442	1,758,086

TABLE 34.—*Total stocks of coke at all furnace and nonfurnace byproduct plants in the United States on first of each month, 1940–41, in net tons*

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Other plants		Total	
	1940	1941	1940	1941	1940	1941
January	905,073	742,306	1,664,617	1,170,828	2,569,690	1,913,134
February	842,123	731,845	1,163,723	864,873	2,005,846	1,596,718
March	783,795	773,666	914,190	617,759	1,697,985	1,391,425
April	800,388	845,329	837,927	491,967	1,638,315	1,337,296
May	930,677	694,433	1,083,632	706,203	2,014,309	1,400,636
June	954,997	741,425	1,105,553	663,714	2,060,550	1,405,139
July	877,078	849,320	935,429	578,343	1,812,507	1,427,663
August	846,352	873,591	1,068,714	576,752	1,915,066	1,450,343
September	807,393	949,868	1,219,423	661,906	2,026,816	1,611,774
October	776,446	880,824	1,281,090	698,764	2,057,536	1,579,588
November	739,770	870,731	1,289,625	744,925	2,029,395	1,615,656
December	713,004	817,004	1,283,970	850,750	1,996,974	1,667,754

TABLE 35.—*Stocks of bituminous coal at byproduct-coke plants in the United States at end of each month, 1938–41, in net tons*

Month	1938	1939	1940	1941
January	6,469,457	7,373,871	6,613,253	9,886,936
February	5,822,943	7,372,654	5,978,167	9,889,674
March	5,231,300	7,221,632	5,373,567	9,853,544
April	4,934,840	4,434,124	5,217,870	4,969,862
May	4,867,332	2,598,470	5,995,170	4,725,310
June	4,999,856	3,548,326	6,506,396	5,912,874
July	5,364,442	4,534,922	7,448,266	6,215,277
August	5,539,623	5,631,984	7,831,640	7,205,844
September	5,951,617	6,220,015	8,860,832	7,291,698
October	6,459,096	7,250,436	9,711,983	8,371,329
November	7,172,900	8,114,807	10,091,259	8,327,472
December	7,462,163	7,992,848	10,184,443	8,901,462

VALUE AND PRICE

In previous years, reference has been made in the Coke chapters to the various accounting methods used by coke operators affiliated with iron and steel plants, by which the coke sometimes is charged to the furnace department at cost and sometimes includes a percentage of profit at the current market price. In the open market, however, price cutting, long-term contracts, and other factors materially affect the prices at which coke-plant operators actually dispose of coke. According to sales data furnished by the operators, average receipts per ton for byproduct coke sold rose as follows: Furnace coke, $0.61; foundry, $1.09; domestic, $0.93; and other industrial, $0.82. Average receipts from the sales of beehive coke in 1941 increased over 1940 as follows: Furnace coke, $1.17; foundry coke, $1.38; domestic coke, $1.05; and other industrial coke, $1.50.

Trade-journal quotations published in 1941 showed that the price of byproduct foundry coke increased in all markets. The increases ranged from $0.96 in New England to $0.33 at St. Louis, Mo. Connellsville prices for beehive coke, usually the basis for the beehive-coke industry, rose $1.50 per ton for furnace coke and $1.14 per ton for foundry coke.

TABLE 36.—*Average receipts per net ton for coke sold in the United States in 1941, by States*

State	Byproduct				Beehive			
	Furnace [1]	Foundry	Domestic	Other industrial, including water gas	Furnace [1]	Foundry	Domestic	Other industrial, including water gas
Alabama	$4.03	$7.91	$4.19	$4.95	$5.52			
Colorado, Utah, and Wisconsin	7.65	11.06	7.73	5.72		$6.43	$3.91	$7.33
Connecticut, Massachusetts, and Rhode Island	8.02	10.75	8.25	8.14				
Illinois	4.91	10.76	6 69	7.25				
Indiana	6 33	(2)	5.71	5.86				
Kentucky, Michigan, and Missouri	5 10	10.27	5.80	6.69		5.86	(2)	
Maryland and New Jersey	(2)	(2)	7 31	7 00				
Minnesota	(2)	(2)	8.66	7.49				
New York	5.94		7.10	7.07				
Ohio	5 46	7 66	5 25	6 46				
Pennsylvania	4.43	10.19	6.33	6.95	5.48	6.29	4.97	5.37
Tennessee and West Virginia	(2)	8.49	4 33	6.47	4.66	7.56	(2)	6 61
Virginia					5 93	6.32	4.68	5.86
Undistributed	6.27	10 47					4.46	
United States average	5.23	9.76	6 96	6.68	5 47	6.49	4.94	5.64
At merchant plants	5 79	10 09	7 30	7 04				
At furnace plants	4.89	8.15	5 35	5.47				

[1] Includes coke sold to affiliated corporations for all other purposes and merchant sales.
[2] Included under "Undistributed."

TABLE 37.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1938–41* [1]

Month	Furnace coke					Foundry coke				
	1929	1938	1939	1940	1941	1929	1938	1939	1940	1941
January	$2.75	$4.00	$3.75	$4 20	$5 50	$3.75	$5.00	$4.75	$5.50	$5.75
February	2.90	4.00	3.75	4.00	5.50	3 75	5 00	4.75	5.31	5.75
March	2 98	4 00	3 75	4 00	5.52	3 75	5 00	4 75	5 25	5.85
April	2.78	4 00	3.75	4 00	5 63	3 75	5.00	4 75	5.25	5.62
May	2 75	4 00	3 75	4 00	6.00	3 75	5.00	4.75	5.25	6.72
June	2 75	3.85	3.75	4.00	6.13	3 75	4.85	4.75	5.25	6.88
July	2 75	3 75	3 75	4.20	6.13	3.75	4.75	4 75	5.25	6.88
August	2 73	3.75	3.75	4 63	6 13	3.75	4.75	4 75	5.25	6.88
September	2.65	3 75	4.25	4.75	6.13	3 75	4 75	5 12	5.25	6.88
October	2.65	3.75	4.90	4 75	6.13	3 75	4 75	5 65	5.25	6.88
November	2 65	3.75	5.00	5.10	6.13	3.75	4.75	5.75	5.63	6.88
December	2 64	3 75	5 00	5.38	6 13	3.75	4.75	5.75	5.75	6.88
Average	2.75	3.86	4.09	4.42	5.92	3.75	4.86	5.02	5.35	6.49

[1] Iron Age.

Table 38.—*Average monthly prices per net ton of byproduct foundry coke in 11 markets in the United States, 1937–41, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Birmingham, Ala. (at ovens):													
1937	$6.50	$6.50	$6.50	$6.95	$7.25	$7.25	$7.25	$7.25	$7.30	$7.50	$7.50	$7.50	$7.10
1938	7.50	7.50	7.50	7.50	7.50	7.50	7.00	7.00	7.00	7.00	7.00	7.00	7.25
1939	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	8.05	7.50	7.12
1940	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
1941	7.50	7.50	7.50	7.50	8.30	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.15
Buffalo, N. Y. (delivered at consumers' works):													
1937	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
1938	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
1939	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.25	11.25	10.62
1940	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.75	11.75	11.33
1941	11.75	11.75	11.75	11.75	12.05	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.21
Chicago, Ill. (at ovens):													
1937	9.50	9.50	9.50	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.06
1938	10.25	10.25	10.25	10.25	10.25	10.25	10.10	9.75	9.75	9.75	9.75	9.75	10.03
1939	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.95	10.50	10.50	9.89
1940	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.00	11.00	11.00	10.62
1941	11.00	11.00	11.00	11.00	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.33
Cincinnati, Ohio (delivered at consumers' works):													
1937	9.70	9.75	9.75	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.31
1938	10.50	10.50	10.50	10.50	10.50	10.50	9.90	9.75	9.75	9.75	9.75	9.75	10.14
1939	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	10.50	10.50	9.88
1940	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.00	11.00	11.00	10.62
1941	11.00	11.00	11.00	11.00	11.30	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.46
Cleveland, Ohio (delivered at consumers' works):													
1937	10.30	10.30	10.30	10.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.05	10.81
1938	11.05	11.05	11.05	11.05	11.05	11.05	10.75	10.30	10.30	10.30	10.30	10.30	10.71
1939	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	11.05	11.05	10.42
1940	11.05	11.05	11.05	11.05	11.05	11.05	11.05	11.05	11.05	11.55	11.55	11.55	11.17
1941	11.55	11.55	11.55	11.55	12.15	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.04
Detroit, Mich. (delivered at consumers' works):													
1937	10.50	10.70	10.70	10.89	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	10.97
1938	11.10	11.10	11.10	11.10	11.10	11.10	10.90	10.25	10.25	10.25	10.25	10.25	10.73
1939	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	11.00	11.00	10.38
1940	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.50	11.50	11.08
1941	11.50	11.50	11.50	11.50	11.80	12.25	12.25	12.25	12.25	12.25	12.25	12.25	11.96
Indianapolis, Ind. (delivered at consumers' works):													
1937	9.60	9.65	9.65	10.33	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.27
1938	10.50	10.50	10.50	10.50	10.50	10.50	10.00	10.00	10.00	10.00	10.00	10.00	10.25
1939	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.75	10.75	10.12
1940	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	11.25	11.25	11.25	10.87
1941	11.25	11.25	11.25	11.25	11.55	12.00	12.00	12.00	12.00	12.00	12.00	12.00	11.71
Newark, N. J. (delivered at consumers' works):													
1937	10.17	10.17	10.17	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.88	10.68
1938	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88
1939	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	11.25	11.38	11.38	10.99
1940	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.87	11.85	11.46
1941	11.85	11.85	11.85	11.85	12.45	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.34
New England (delivered at consumers' works):													
1937	12.00	12.00	12.00	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.38
1938	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
1939	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
1940	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
1941	12.50	13.00	13.00	13.00	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.46
Philadelphia, Pa. (delivered at consumers' works):													
1937	9.85	9.85	9.85	10.40	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.40
1938	10.62	10.63	10.63	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.64
1939	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	11.02	11.15	11.15	10.76
1940	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.63	11.63	11.23
1941	11.63	11.63	11.63	11.63	12.13	12.38	12.38	12.38	12.38	12.38	12.38	12.38	12.11
St. Louis, Mo. (delivered at consumers' works):													
1937	10.10	10.50	10.50	10.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	10.83
1938	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
1939	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.75	11.75	11.12
1940	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75
1941	11.75	11.75	11.75	11.75	12.15	12.25	12.25	12.25	12.25	12.25	12.25	12.25	12.08

SHIPMENTS BY RAIL, WATER, AND TRUCK

TABLE 39.—*Beehive coke loaded for shipment on originating railroads, waterways, and trucks in the United States in 1941, by routes, as reported by coke producers*

Route	State	Net tons		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania	1,040,511	1,081,943	16.8
	West Virginia	41,432		
Chesapeake & Ohio	West Virginia	45,679	45,679	.7
Denver & Rio Grande Western	Colorado	84,923	95,316	1.5
	Utah	10,393		
Huntingdon & Broad Top Mountain	Pennsylvania	10,088	10,088	.2
Interstate	Virginia	281,534	281,534	4.4
Ligonier Valley	Pennsylvania	66,543	66,543	1.0
Louisville & Nashville	Kentucky	1,834	100,543	1.6
	Alabama	98,709		
Monongahela	Pennsylvania	1,571,276	1,571,276	24.2
Nashville, Chattanooga, & St. Louis	Tennessee	17,432	17,432	.3
New York Central	West Virginia	172,850	172,850	2.7
Norfolk & Western	Virginia	42,820	42,820	.7
Pennsylvania	Pennsylvania	2,784,656	2,784,656	43.0
Pittsburgh & Lake Erie	do	110,644	110,644	1.7
Total railroad shipments		6,381,324	6,381,324	98.8
Waterways: Monongahela and Ohio Rivers	Pennsylvania	48,151	48,151	.8
Trucks		[1] 27,615	27,615	.4
Grand total		6,457,090	6,457,090	100.0

[1] Coke delivered by trucks to consumers in all States that produced beehive coke.

DISTRIBUTION OF BYPRODUCT AND BEEHIVE COKE IN 1941

Coke shipped by producers, or used by them, is shown by States and regions of destination and by uses in this analysis. The tonnage shipped to each destination represents approximately the coke consumed therein; and, for practical purposes, the terms "distribution" and "consumption" are interchangeable in this connection. However, the total coke shipped and used by producers shown in this separate study of coke distribution differs slightly from the total "calculated" consumption of coke in 1941, shown in the preceding section on Consumption of Coke.

The national consumption of byproduct and beehive coke, not including imports, in 1941, totaled 64,876,457 tons, a 13-percent increase over the 1940 total of 57,170,633 tons. Pennsylvania led in total tonnage consumed, with 17,867,567 tons, followed by Ohio, New York, Indiana, and Illinois in the order named.

As activity in the coke industry follows closely that in the iron and steel industry, it is interesting to note that the increase in blast-furnace coke consumption paralleled the increase in total coke production in 1941. Of the 64,876,457 tons of coke consumed in 1941, 50,331,675 tons went into blast furnaces. The trend of coke consumption from domestic to metallurgical use can be seen from the decrease in domestic tonnage from 1940. In 1941, 6,660,847 tons of domestic coke were consumed compared with 7,974,308 tons in 1940.

Every State in the Union, as well as the District of Columbia, consumed foundry coke during 1941. The total, amounting to 2,787,527 tons, was 35 percent greater than in 1940. Coke used for making producer gas and water gas and for other industrial uses increased

8 percent, with a tonnage of 5,096,408 tons compared with 4,732,890 tons in 1940.

The total consumption of breeze in the United States in 1941 amounted to 4,651,982 net tons, an increase of 582,289 tons over the 1940 figure.

The consumption by uses in 1941, by geographical regions, is shown in table 41. When compared with 1940, consumption increased in seven of the nine regions and decreased in two of them. The largest increase was in the Ohio region, which gained 25 percent over the 1940 figure, followed by the Illinois-Indiana region, with a gain of 21 percent. The Missouri Valley region had the greatest decrease in coke requirements, with a 16-percent decline from the 1940 total, and Michigan declined 10 percent.

Table 42 shows where the coke produced in each State was consumed. Although Alabama shipped coke into the greatest number of States in 1941, the tonnage was relatively small, as 92 percent of the coke produced in the State was consumed there. Pennsylvania shipped into 27 States, leading the Nation in total tonnage shipped outside the State with 3,902,258 tons. Indiana, which was second highest, shipped 1,935,028 net tons in 1941.

TABLE 40.—*Summary of byproduct and beehive coke and breeze consumed in each State in 1941, in net tons*

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1941. Does not include imported coke, which totaled 241,690 net tons from January to September, inclusive]

Consuming State	Coke							Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Alabama	4,140,855	164,668			60,799	74,634	4,440,956	288,025
Arizona		6,500			315	72	6,887	
Arkansas		(1)		(1)		(1)	(1)	14,944
California	20,375	72,657			24,343	25	117,400	137
Colorado	573,925	21,969		144	19,534	568	616,140	39,034
Connecticut		48,562	84,442	52,961	11,205	202,160	399,330	54,993
Delaware	284	4,227		412	7,186	1,389	13,498	2,135
District of Columbia		(1)		(1)	189	1,554	62,335	
Florida		1,641		29,948	878	4,340	36,807	(1)
Georgia	1,220	19,147		7,197	5,755	13,692	47,011	
Idaho		2,873			2,640		5,513	84
Illinois	4,369,826	241,538	28,119	31,749	115,447	615,516	5,402,195	304,686
Indiana	5,231,850	145,936		31,828	162,184	240,598	5,812,396	408,901
Iowa		52,074		6,981	28,440	8,657	96,152	5,342
Kansas		10,690			3,413	54	14,157	738
Kentucky	281,364	21,897		14,627	8,084	36,838	362,810	41,945
Louisiana		3,785			24,824	4,878	33,487	43
Maine		(1)		(1)		52,826	61,588	
Maryland	1,920,995	36,550		37	57,581	27,666	2,042,829	154,504
Massachusetts	(1)	(1)	77,000	92,121	2,078	884,798	1,200,719	108,431
Michigan	1,058,522	415,126	37,227	4,405	219,576	773,560	2,508,416	195,444
Minnesota	282,693	24,764	4,165		24,908	304,129	640,659	51,153
Mississippi		1,060			330	2,260	3,650	
Missouri	121	51,836		206	72,778	136,286	261,227	2,615
Montana	23,988	2,515			5,200		31,703	19,386
Nebraska	108	5,987		15,843	6,551	806	29,295	22
Nevada		56			6,857		6,913	
New Hampshire		(1)		(1)	312	54,281	60,066	
New Jersey	105	122,896	94,312	225,852	102,634	470,330	1,016,129	89,557
New Mexico		1,259			336	24	1,619	
New York	3,395,181	201,752	308,225	686,306	251,219	1,349,687	6,192,370	409,209
North Carolina	192	15,406		6,082	1,433	2,710	25,823	
North Dakota		(1)		163	138	1,295	(1)	
Ohio	11,005,454	307,127	2,234	16,216	267,761	342,508	11,941,300	677,515
Oklahoma		3,476			(1)	(1)	3,920	21,880
Oregon		4,871			5,056		9.927	

[1] Included under "Undistributed."

TABLE 40.—*Summary of byproduct and beehive coke and breeze consumed in each State in 1941, in net tons*—Continued

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1941. Does not include imported coke, which totaled 241,690 net tons from January to September, inclusive]

Consuming State	Coke							Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Pennsylvania	16,663,593	331,451	69,450	68,797	259,805	474,471	17,867,567	1,396,305
Rhode Island		15,613	24,737	2,460	3,798	147,408	194,016	18,650
South Carolina	64	4,397		2,848	353	3,120	10,782	477
South Dakota		(1)			(1)	2,156	2,866	
Tennessee	140,162	76,177		149	70,873	5,102	292,463	77,809
Texas	18,824	24,471			16,940	1,076	61,311	22,586
Utah	(1)	18,074			50,472	(1)	242,799	(1)
Vermont		8,141		2,034	2,958	21,727	34,860	
Virginia	74,491	46,514		345,156	87,936	10,206	564,303	163
Washington		8,111			3,287	182	11,580	2,145
West Virginia	874,483	25,678		458,177	85,428	2,561	1,446,327	129,472
Wisconsin	30	139,350	59,858	34,595	15,745	381,350	630,928	90,301
Wyoming		(1)			7,135	(1)	7,949	
Undistributed	252,970	76,705		64,091	540	3,347	3,479	23,351
United States total	50,331,675	2,787,527	789,769	2,201,385	2,105,254	6,660,847	64,876,457	4,651,982

[1] Included under "Undistributed."

TABLE 41.—*Comparative tonnages of byproduct and beehive coke consumed in each State and region, 1940–41, in net tons*

[Exclusive of imported coke and of screenings or breeze]

Consuming region and State	Furnace use		Foundry use		Other industrial and domestic use		Total coke	
	1940	1941	1940	1941	1940	1941	1940	1941
New England:								
Maine			(1)	(1)	[1] 54,610	[1] 61,588	54,610	61,588
New Hampshire			1,443	(1)	57,325	[1] 60,066	58,768	60,066
Vermont			5.433	8,141	35,878	26,719	41,311	34,860
Massachusetts	88,830	(2)	48,872	(2)	1,095,954	[2] 1,200,719	1.233,656	1,200,719
Connecticut			34,847	48,562	331,674	350,768	366 521	399,330
Rhode Island			(1)	15,613	[1] 189,393	178,403	189,393	194,016
	88,830	(2)	90 595	72,316	1,764,834	[2] 1,878,263	1,944,259	1,950,579
Middle Atlantic:								
New York	2,615,108	3,395,181	141,372	201,752	2,947,521	2,595,437	5,704,001	6,192,370
New Jersey	651	105	86,161	122,896	921,763	893,128	1.008.575	1,016,129
Pennsylvania	14,319,836	16,668,593	219,232	331,451	850,635	872,523	15,389,703	17,867,567
Delaware	764	284	2,758	4,227	3,524	8,987	7,046	13,498
Maryland	1,849,917	1,920,995	23,891	36,550	85,487	85,284	1,959,295	2,042,829
Dist. of Columbia			395	(1)	66,935	[1] 62,335	67,330	62,335
	18,786,276	21,980,158	473,809	696,876	4,875,865	4,517,694	24,135,950	27,194,728
Ohio	8,619,762	11,005,454	304,373	307,127	652,815	628,719	9,576,950	11,941,300
Michigan	1,076,370	1,058,522	333,791	415,126	1,389,182	1,034,768	2,799,343	2,508,416
Illinois-Indiana:								
Illinois	3,332,028	4,360,826	172,455	241,538	857,653	790,831	4,362,136	5,402,195
Indiana	4,305,518	5,231,850	106,063	145,936	518,413	434,610	4,929,994	5,812,396
	7,637,546	9,601,676	278,518	387,474	1,376,066	1,225,441	9,292,130	11,214,591
Missouri Valley:								
Missouri	19,144	121	34,426	51,836	313,661	209,270	367,231	261,227
Iowa			33,721	52,074	42,101	44,078	75,822	96,152
Nebraska	(3)	108	2,320	5,987	[3] 20,996	23,200	23,316	29,295
Kansas			7,510	10,690	2,837	3,467	10,347	14,157
	19,144	229	77,977	120,587	379,595	280,015	476,716	400,831

See footnotes at end of table.

TABLE 41.—*Comparative tonnages of byproduct and beehive coke consumed in each State and region, 1940–41, in net tons*—Continued

Consuming region and State	Furnace use		Foundry use		Other industrial and domestic use		Total coke	
	1940	1941	1940	1941	1940	1941	1940	1941
Lake Dock region:								
Wisconsin	----------	30	99,327	139,350	553,703	491,548	653,030	630,928
Minnesota	225,569	282,693	15,684	24,764	373,685	333,202	614,938	640,659
North Dakota	----------	----------	----------	(4)	1,758	1,596	1,758	(4)
South Dakota	----------	----------	(1)	(1 4)	[1] 2,449	[1] 2,927	2,449	[4] 4,523
	225,569	282,723	115,011	164,114	931,595	829,273	1,272,175	1,276,110
Southeast:								
Virginia	52,715	74,491	31,258	46,514	383,798	443,298	467,771	564,303
West Virginia	787,694	874,483	12,657	25,678	479,082	546,166	1,279,433	1,446,327
North Carolina	----------	192	13,410	15,406	10,522	10,225	23,932	25,823
South Carolina	----------	64	3,613	4,397	5,896	6,321	9,509	10,782
Georgia	----------	1,220	13,765	19,147	26,435	26,644	40,200	47,011
Florida	----------	----------	1,017	1,641	35,251	35,166	36,268	36,807
Kentucky	[5] 276,223	281,364	20,341	21,897	(5)	59,549	296,564	362,810
Tennessee	54,312	140,162	59,724	76,177	63,113	76,124	177,149	292,463
Alabama	4,099,434	4,140,855	123,394	164,668	142,084	135,433	4,364,912	4,440,956
Mississippi	----------	----------	(1)	1,060	[1] 2,206	2,590	2,206	3,650
	5,270,378	5,512,831	279,179	376,585	1,148,387	1,341,516	6,697,944	7,230,932
Southwest, Mountain, and Pacific:								
Louisiana	----------	----------	2,883	3,785	29,030	29,702	31,913	33,487
Arkansas	----------	----------	1,444	(6)	605	(6)	2,049	(6)
Oklahoma	----------	----------	2,205	[6] 4,734	191	[6] 1,008	2,396	[6] 5,742
Texas	16,286	18,824	15,991	24,471	15,348	18,016	47,625	61,311
New Mexico	----------	----------	(1)	1,259	[1] 1,237	360	1,237	1,619
Arizona	----------	----------	4,053	6,500	295	387	4,348	6,887
Colorado	521,698	573,925	11,604	21,969	12,592	20,246	545,894	616,140
Utah	163,790	[5] 224,725	10,337	18,074	57,347	(5)	231,474	242,799
Nevada	----------	----------	28	56	29	6,857	57	6,913
Wyoming	----------	----------	----------	(1)	2,472	[1] 7,949	2,472	7,949
Montana	19,494	23,988	2,060	2,515	3,230	5,200	24,793	31,703
Idaho	----------	----------	(1)	2,873	[1] 3,900	2,640	3,900	5,513
Washington	----------	----------	3,089	8,111	1,630	3,469	4,719	11,580
Oregon	----------	----------	2,821	4,871	1,788	5,056	4,609	9,927
California	(7)	20,375	[7] 47,720	72,657	19,960	24,368	67,680	117,400
	721,268	861,837	104,235	171,875	149,663	125,258	975,166	1,158,970

[1] Foundry included under other industrial.
[2] Furnace and foundry included under other industrial.
[3] Furnace included under other industrial.
[4] North Dakota included under South Dakota.
[5] Other industrial included under furnace.
[6] Arkansas included under Oklahoma.
[7] Furnace included under foundry.

TABLE 42.—*Distribution of coke shipped or used by producer in 1941, by destinations, in net tons*

PRODUCED IN ALABAMA

Destination	Coke					Coke breeze
	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	
Alabama	4,137,950	160,239	46,478	74,634	4,419,301	288,025
Arizona, Colorado, and Utah	----------	3,916	111	----------	4,027	----------
Arkansas, Oklahoma, and Texas	----------	25,466	16,517	1,107	43,090	12,078
California	----------	13,208	9,290	----------	22,498	----------
Florida	----------	1,567	30,733	4,340	36,640	(1)
Georgia	----------	16,246	12,454	13,571	42,271	----------
Illinois	----------	10,010	3,691	14,432	28,133	91
Indiana	----------	7,657	332	1,217	9,206	----------
Iowa	----------	----------	32	204	236	----------
Kansas	----------	(1)	(1)	----------	759	----------

See footnotes at end of table.

TABLE 42.—*Distribution of coke shipped or used by producer in 1941, by destinations, in net tons*—Continued

PRODUCED IN ALABAMA—Continued

Destination	Coke: For blast-furnace use	Coke: For foundry use	Coke: For other industrial use	Coke: For domestic use	Coke: Total coke	Coke breeze
Kentucky		5,112	(1)	(1)	6,229	
Louisiana		3,669	24,824	4,777	33,270	(1)
Michigan, New Jersey, and Ohio		52,902	110		53,012	
Mississippi		1,060	330	2,260	3,650	
Missouri		6,916	1,002	396	8,314	815
Montana, Oregon, and Washington		775	1,695		2,470	
Nebraska			(1)	(1)	86	
North Carolina		2,890	(1)	(1)	10,957	
South Carolina		2,796	(1)	(1)	7,782	
Tennessee	5,013	37,057	13,294	4,623	59,987	67,707
Virginia		9,535	(1)	(1)	14,009	
Wyoming		(1)	(1)		1,141	
Undistributed		1,351	14,007	5,272		4,357
	4,142,963	362,372	174,900	126,833	4,807,068	378,073

PRODUCED IN COLORADO AND UTAH

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Arizona		1,977	315	72	2,364	
Arkansas						4,443
California	20,347	1,363	3,367		25,077	137
Colorado	573,925	15,474	17,690	568	607,657	39,034
Idaho		2,836	2,640		5,476	84
Illinois			25		25	
Iowa			61		61	
Kansas		1,011	1,989	54	3,054	738
Montana	23,988	184	583		24,755	19,386
Nebraska	108	59	6,277	336	6,780	22
Nevada		56	6,857		6,913	
New Mexico		153	336	24	513	
Oklahoma			27	364	391	21,880
Oregon			4,849		4,849	
South Dakota			47		47	
Texas	18,797	193	965		19,955	12,513
Utah	171,304	5,405	50,472	2,949	230,130	19,087
Washington		183	3,220	182	3,585	2,076
Wyoming			4,048	3	4,051	
	808,469	28,894	103,768	4,552	945,683	119,350

PRODUCED IN CONNECTICUT, MASSACHUSETTS, AND RHODE ISLAND

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Connecticut		41,196	135,182	202,118	378,496	42,926
Maine		6,485	2,277	52,402	61,164	
Massachusetts	(2)	[2] 141,630	158,250	875,981	1,175,861	108,310
New Hampshire		4,601	176	47,478	52,255	
New York		18,866		63	18,929	
Pennsylvania		7,391			7,391	
Vermont		8,141	128	5,983	14,252	
Rhode Island		15,175	30,995	147,374	193,544	18,650
	(2)	[2] 243,485	327,008	1,331,399	1,901,892	169,886

PRODUCED IN ILLINOIS

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Arkansas, Nebraska, and Oklahoma		4,366			4,366	8,462
Arizona, South Dakota, and Utah		5,799		408	6,207	
California, Oregon, and Washington		8,889			8,889	69
Colorado		5,902			5,902	
Illinois	2,524,644	129,371	134,892	576,236	3,365,143	269,276
Indiana	9,631	34,553	6,663	10,618	61,465	16,636
Iowa		34,325	2,918	2,929	40,172	685
Kansas		(1)	(1)		3,798	
Michigan		53,417	726		54,143	3,277
Minnesota		10,362			10,362	
Missouri		(1)	(1)	98,601	(1)	1,170
Ohio		(1)			(1)	
Wisconsin		32,228	2,087	45,170	79,485	4,980
Undistributed		32,473	4,490		131,766	
	2,534,275	351,685	151,776	733,962	3,771,698	304,564

See footnotes at end of table.

TABLE 42.—*Distribution of coke shipped or used by producer in 1941, by destinations, in net tons*—Continued

PRODUCED IN INDIANA

Destination	Coke					Coke breeze
	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	
California		17,436			17,436	
Illinois	1,643,209	66,853	15,404	13,185	1,738,651	25,066
Indiana	5,108,258	75,945	130,234	167,311	5,481,748	392,131
Iowa		10,662	4,825	2,444	17,931	4,657
Kansas		494	162		656	
Kentucky		156			156	
Michigan		69,618	234	5,286	75,138	
Minnesota		4,318			4,318	
Missouri		6,393	474	628	7,495	
Montana		2,109			2,109	
Nebraska		203	43		246	
Ohio		26,691	31	348	27,070	
Oklahoma		579			579	
Oregon		1,487	170		1,657	
Washington		1,635			1,635	
Wisconsin		28,755	7,136	2,497	38,388	35,000
	6,751,467	313,334	158,713	191,699	7,415,213	456,854

PRODUCED IN KENTUCKY, MISSOURI, TENNESSEE, AND VIRGINIA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama	2,905	4,297	11,515		18,717	
California	28	8,082	207		8,317	
District of Columbia		28	3,719		3,747	
Florida		64	93		157	
Georgia	1,220	2,901	498	121	4,740	
Illinois	75,120	8,673	20,472	1,032	105,297	9,377
Indiana	276	3,080	(1)	(1)	30,093	
Iowa		371	19,754	180	20,305	
Kansas		2,094	1,009		3,103	
Kentucky	281,364	11,701	21,999	20,261	335,325	(1)
Louisiana		116		101	217	
Maryland		4,939			4,939	
Michigan		788	(1)	(1)	33,648	
Missouri	121	22,629	66,947	36,661	126,358	630
Nebraska			5,179		5,179	
New York		54	1,271		1,325	
North Carolina	192	12,516	1,016	872	14,596	
North Dakota, Oregon, and Washington		3,227			3,227	
Ohio		11,786	(1)	(1)	118,864	(1)
Oklahoma		867			867	
South Carolina	64	1,336	347	938	2,685	477
Tennessee	135,149	39,120	57,728	479	232,476	9,578
Texas	27	296			323	34
Utah		3,583			3,583	
Virginia	73,728	24,027	188,925	5,171	291,851	136
West Virginia		3,038	(1)	(1)	18,914	
Wisconsin		277			277	
Undistributed			58,175	124,376		40,165
	570,194	169,890	458,854	190,192	1,389,130	60,397

PRODUCED IN MARYLAND

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Delaware			38		38	
Maryland	1,677,943		46,429	23,502	1,747,874	154,504
	1,677,943		46,467	23,502	1,747,912	154,504

PRODUCED IN MICHIGAN, MINNESOTA, AND WISCONSIN

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Arizona, Oklahoma, and Texas		1,678			1,678	
California		24,183	11,479		35,662	
Colorado		(1)	(1)		2,338	
Idaho		37			37	
Illinois	(1)	23,352	(1)	(1)	47,498	(1)
Indiana	76,604	(1)	(1)	(1)	112,374	

See footnotes at end of table.

TABLE 42.—*Distribution of coke shipped or used by producer in 1941, by destinations, in net tons*—Continued

PRODUCED IN MICHIGAN, MINNESOTA, AND WISCONSIN—Continued

Destination	Coke: For blast-furnace use	Coke: For foundry use	Coke: For other industrial use	Coke: For domestic use	Coke: Total coke	Coke breeze
Iowa		6,716	1,815	2,900	11,431	
Kansas, Nebraska, and North Dakota		4,704	11,088	1,608	17,400	
Kentucky, Ohio, and West Virginia	(1)	104,713	4,040	(1)	108,866	327
Michigan	1,056,112	179,764	236,611	672,078	2,144,565	185,410
Minnesota	282,693	10,054	29,073	304,129	625,949	51,153
Missouri		7,502			7,502	
Montana		138	2,922		3,060	
New Jersey, Pennsylvania, and Rhode Island		6,124	10		6,134	377
New Mexico		1,106			1,106	
New York	251,041	(1)	(1)		305,019	(1)
Oregon		1,808	37		1,845	
South Dakota			413	1,748	2,161	
Utah		3,539			3,539	
Washington		1,281	67		1,348	
Wisconsin		77,479	100,650	333,683	511,812	50,312
Wyoming			2,757		2,757	
Undistributed	13,441	65,122	27,585	10,197		642
	1,679,891	519,300	428,547	1,326,343	3,954,081	288,221

PRODUCED IN NEW JERSEY

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
New Jersey		49,464	372,632	432,280	854,376	85,468
New York		7,295	135,407	35,163	177,865	283
Pennsylvania		427	630		1,057	
		57,186	508,669	467,443	1,033,298	85,751

PRODUCED IN NEW YORK

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Connecticut			152		152	
Massachusetts			12,851	6,512	19,363	
Michigan			(1)		(1)	
New Hampshire			(1)	(1)	5,423	
New Jersey			21,897	22,051	43,948	
New York	2,715,700	3,066	1,085,406	1,180,139	4,984,311	363,852
Pennsylvania			(1)	(1)	(1)	
Vermont			4,864	12,659	17,523	
Undistributed			14,050	5,225	13,852	
	2,715,700	3,066	1,139,220	1,226,586	5,084,572	363,852

PRODUCED IN OHIO

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama, Kentucky, and North Carolina		1,219	2,831	15,786	19,836	1,790
Illinois, Indiana, and Iowa	40,798	12,007	18,571	44,249	115,625	
Michigan and Pennsylvania	24,716	88,309	650	57,293	170,968	5,107
New York	24,464	24,647	851	468	50,430	12,631
Ohio	8,074,721	106,292	143,019	236,666	8,560,698	671,422
Virginia and West Virginia	62,337	301	248,344	2,838	313,820	
	8,227,036	232,775	414,266	357,300	9,231,377	690,950

PRODUCED IN PENNSYLVANIA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Connecticut		7,366	13,274	42	20,682	12,067
Delaware	284	4,203	7,500	1,365	13,352	2,135
District of Columbia		(1)	56,819	(1)	58,073	
Florida and South Carolina		(1)		(1)	60	
Illinois	100,757	449	141	461	101,808	
Indiana	9,014	915	8,867	1,124	19,920	
Kansas		25			25	

See footnotes at end of table.

TABLE 42.—*Distribution of coke shipped or used by producer in 1941, by destinations, in net tons*—Continued

PRODUCED IN PENNSYLVANIA—Continued

Destination	Coke					Coke breeze
	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	
Kentucky		63			63	
Maine				424	424	
Maryland	225,045	30,466	4,688	4,164	264,363	
Massachusetts	1,105	940	98	1,971	4,114	121
Michigan	2,410	1,748	1,525	12,180	17,863	
Minnesota		30			30	
Missouri		590	17		607	
Nebraska			76	103	179	
New Hampshire			398	1,730	2,128	
New Jersey	105	71,606	25,605	14,263	111,579	3,811
New York	403,976	93,287	22,316	130,852	650,431	16,275
Ohio	2,203,783	16,988	113,284	22,025	2,356,080	3,549
Oklahoma		73			73	
Pennsylvania	16,550,320	238,084	366,692	467,500	17,622,596	1,395,769
Rhode Island				34	34	
Texas		24	44		68	
Vermont				3,085	3,085	
Virginia		3,051	5,607	989	9,647	
West Virginia	114,089	18,716	2,469	648	135,922	18,847
Wisconsin	30	25	325		380	
Undistributed		165		1,149		
	19,610,918	488,814	629,745	664,109	21,393,586	1,452,574

PRODUCED IN WEST VIRGINIA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama		132			132	
Arizona		82			82	
California		2,143		25	2,168	
Colorado		39			39	
Delaware		24	60	24	108	
District of Columbia			60	455	515	
Illinois		2,830	51	28	2,909	262
Indiana		597	30	85	712	134
Kansas		32			32	
Kentucky		1,820	233		2,053	
Maryland	18,007	1,145	6,501		25,653	
Massachusetts		1,047		334	1,381	
Michigan		6,614	990	787	8,391	1,650
Missouri		278	88		366	
Montana		84			84	
Nebraska		30			30	
New Hampshire				260	260	
New Jersey		1,763	2,664	1,736	6,163	
New York		1,058		3,002	4,060	16,140
North Carolina			245		245	
Ohio	726,950	4,066	1,322	1,022	733,360	2,207
Pennsylvania	88,557	61,049	30,718	6,559	186,883	437
South Carolina		265			265	
Virginia	763	9,659	10,106	786	21,314	27
West Virginia	697,981	1,944	501,407	1,824	1,203,156	110,625
Wisconsin		586			586	
	1,532,258	97,287	554,475	16,927	2,200,947	131,482

[1] Included under "Undistributed."
[2] Coke for blast-furnace use included under coke for foundry use.

EXPORTS AND IMPORTS [3]

The export movement of coke in 1941 was small compared with the total tonnage produced. From January through September 1941—the only period of the year for which foreign trade figures can be pub-

[3] Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

lished—the exports of coke from the United States totaled 525,223 net tons valued at $4,021,357.

Imports of coke constitute a small part of this country's requirements in normal times. However, the need for coke by the metallurgical industry in 1941 resulted in more than doubling the 1940 imports during the first 9 months. The imports of coke are a factor in the home market only in certain localities. The entire tonnage of coke received by the United States from January through September 1941 was furnished by the United Kingdom and Canada, the largest tonnages coming through ports in Maryland, Massachusetts, and Buffalo.

TABLE 43.—*Coke exported from the United States, 1937–41*

Year	Net tons	Value	Year	Net tons	Value
1937	526,683	$3,567,828	1940	804,095	$5,024,992
1938	486,571	3,035,105	1941 (Jan.-Sept.)	525,223	4,021,357
1939	589,925	3,878,235			

TABLE 44.—*Coke imported for consumption in the United States, 1939–41, by countries and customs districts*

	1939		1940		1941 (Jan.-Sept.)	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
Belgium	37,080	$152,606				
Canada	85,818	1,129,337	77,642	$1,114,683	63,481	$886,244
Germany	4,321	26,126				
Netherlands	10	80				
United Kingdom	14,682	79,023	34,908	190,457	178,209	940,512
	141,911	1,387,172	112,550	1,305,140	241,690	1,826,756
CUSTOMS DISTRICT						
Buffalo	55,425	956,814	47,377	949,150	34,016	725,080
Connecticut					3,793	27,880
Los Angeles	11,392	64,458	3,035	13,548	1,690	11,870
Maine and New Hampshire	350	2,590	292	2,145	146	1,102
Maryland			3,390	27,241	107,169	579,442
Massachusetts	10,976	43,871	14,091	74,196	60,062	289,517
Michigan	11	65	10	74	9	76
Montana and Idaho	26,688	148,183	26,885	141,598	27,191	145,626
New York	19,211	69,445	10,782	54,888	3,351	16,752
Oregon	1,156	6,418				
St. Lawrence	76	486	65	446		
San Francisco	9,849	53,879	3,611	20,619	2,143	15,051
Vermont	278	1,775	291	2,247	314	2,591
Washington State	6,499	39,188	2,721	18,988	1,806	11,769
	141,911	1,387,172	112,550	1,305,140	241,690	1,826,756

WORLD PRODUCTION

In consequence of the European War of 1939 and 1940, which expanded into a world war involving the United States in 1941, the number of countries releasing data on the production of coke decreased steadily. The statistics submitted in table 45 are incomplete, as data from the principal producing countries other than the United States are not available; however, Canada, as well as the United States, surpassed the peak year of 1929 in the production of coke.

TABLE 45.—*Coke produced in principal countries of the world, 1929 and 1938–41, in metric tons* [1] [2]

[Compiled by B. B. Waldbauer]

Country [2]	1929	1938	1939	1940	1941
Australia:					
New South Wales	471,813	1,153,670	1,370,814	(3)	(3)
Queensland	4,144	31,481	31,057	(3)	(3)
Belgium	6,192,960	4,894,980	5,176,650	(3)	(3)
Bulgaria	-----	3,923	4,758	6,000	(3)
Canada	1,986,532	1,808,588	1,830,425	2,321,775	2,432,791
China (exports)	13,467	11,630	22,562	18,456	[4] 11,918
Czechoslovakia	3,170,629	[5] 2,367,000	(3)	(3)	(3)
France	9,080,127	7,785,000	(3)	(3)	(3)
Germany	39,421,033	43,511,082 (Germany and Saar)	(3)	(3)	(3)
Saar	2,423,000				
Great Britain [6]	13,637,421	13,031,396	(3)	(3)	(3)
Hungary	2,092	53,092	(3)	(3)	(3)
India, British [7]	843,504	1,738,178	1,947,455	(3)	(3)
Indochina	637	3,503	4,022	2,608	(3)
Italy	791,607	1,739,417	(3)	(3)	(3)
Mexico	493,777	(3)	(3)	(3)	(3)
Netherlands	2,402,566	3,158,065	[8] 2,207,501	(3)	(3)
New Caledonia	-----	43,317	(3)	80,000	(3)
Peru	35,899	-----	(3)	(3)	(3)
Poland	1,858,052	2,523,290	(3)	(3)	(3)
Rhodesia, Southern	100,001	47,986	32,785	(3)	(3)
Rumania	-----	86,030	(3)	(3)	(3)
Spain	768,040	571,469	685,000	845,000	[9] 407,000
Sweden	103,778	112,107	115,150	(3)	(3)
Turkey	-----	84,930	63,472	60,192	(3)
Union of South Africa	99,297	163,315	184,522	(3)	(3)
U. S. S. R	4,700,000	20,700,000	16,670,000	16,500,000	(3)
United States	54,325,427	29,479,553	4 ,212,242	51,774,699	59,135,960
	142,926,000	[10] 135,103,000	(3)	(3)	(3)

[1] Gas-house coke is not included.
[2] In addition to countries listed, coke is produced in Chosen and Japan, but data of production are not available.
[3] Data not available.
[4] January to August, inclusive.
[5] Excluding Sudetenland since October.
[6] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was 13,049,139 tons in 1938.
[7] Figures for 1929 represent "hard" and "soft" coke made at collieries only—73,616 tons of "hard" coke and 769,888 tons of "soft" coke. Data for other years shown represent total "hard" coke manufactured. In addition, the following quantities of "soft" coke were made at collieries: 1938, 921,479 tons; 1939, data not available.
[8] Incomplete figure (from coke plants of only 2 mines).
[9] January to June, inclusive.
[10] Exclusive of Mexico.

COKE-OVEN BYPRODUCTS

SUMMARY OF BYPRODUCTS

The acute demand for toluol, benzol, phenol, naphthalene, and other valuable byproducts recovered from the carbonization of coal has definitely enhanced the importance of these commodities in the national economy. Basic materials derived from the distillation of coal in byproduct ovens are not only vital to the war program, but they are also an important source of revenue to plant operators and a means of reducing to a minimum the net cost of converting coal to coke. Approximately one-fifth of the annual production of bituminous coal in the United States is consumed in byproduct ovens, a tonnage exceeded only by that consumed by railway locomotives. The increased production of coke for metallurgical purposes has augmented the production of all primary byproducts, the demand for which, fortunately, has also increased. In the past, however, conditions governing the demand for all the byproducts of the coking process have not always been favorable, and their economic distribution has been a problem to producers.

Because of the complex nature of many coke byproducts, which require special technical processes, equipment, and operating technique for their economical production, most byproduct coke plants do not have the necessary facilities for complete processing of the byproducts and are concerned only with the major byproducts—gas, tar, light oil and its derivatives, and ammonia (table 46).

The total output of coke byproducts reached an all-time high in 1941, although the total value was slightly less than in 1929 due to the lower selling prices of ammonium sulfate and light-oil derivatives. In 1941 the total sales value of all coke byproducts exceeded that of 1940 by $13,727,307 and totaled $158,809,184. This figure represented 50 percent of the value of the coke produced in byproduct ovens. From these figures it can readily be seen why the byproduct ovens have largely replaced the beehive ovens in the coke industry (see also fig. 2). Of interest is the increased output and value of distillate creosote oil. Production in 1941 totaled 38,283,662 gallons compared with 27,150,656 gallons in 1940, an increase of 41 percent. Sales of distillate creosote oil rose from 62 percent of the total production in 1940 to 102 percent in 1941, thereby increasing the value of sales from $1,832,348 to $4,583,327. Tar-acid oil, another tar derivative, is also worthy of mention. The major use of creosote is in wood preservation, and tar-acid oils are used in the manufacture of plastics, disinfectants, and dips and for ore flotation.

Gas.—As gas is now the most valuable coke-oven byproduct, it is given special attention in the following tables. Tables 47 and 48 present details of the quantities recovered, used, and sold in 1941, by States. In addition to supplying the fuel needs of the coke ovens, a surplus of 554,126,449 M cubic feet (62 percent of the total of 892,819,811 M cubic feet of gas produced) was sold or used for industrial purposes and for distribution through city mains. Receipts from gas sold by byproduct-coke plants in 1941 totaled $85,040,609, an advance of $3,638,562 over the 1940 figure of $81,402,047. The average unit price for 1941, as reported by the operators, was $0.153 per M cubic feet, a decrease of $0.002 per M cubic feet from the 1940 price of $0.155. The sale of surplus gas produced approximately 53 percent of the total revenue derived from all the byproducts in 1941.

Tar.—Tar, a very important coke byproduct, is the basic material for hundreds of chemical compounds. The crude tar recovered requires special equipment for complete processing, and many plants that are not equipped to process the tar sell their crude tar to refineries. Statistics on the topping of coal tar were collected by the Bureau of Mines for the first time in 1940, when 94,890,278 gallons were topped. The tar topped in 1941 totaled 103,653,501 gallons. Topping is practiced to obtain from tar at byproduct plants, where complete refining equipment is not available, certain constituents, including light oil and tar acid fractions, and in some plants, even higher fractions. Growing recognition of the importance of creosote oil, a derivative of coal tar, is indicated by the increase in its production and value in 1941. The wasteful practice of burning tar for fuel is steadily being discontinued, and the recovery of its valuable constituents is being practiced by more plants each year. Statistics on the production and sales of coke-oven tar during 1941 are shown in table 49.

Ammonia.—Another major byproduct of the coke ovens is ammonia. It is used in the manufacture of nitric acid, explosives, and commer-

cial fertilizers. The relatively low cost of making ammonium sulfate from the ammonia recovered in the carbonization of coal and the large demand for sulfate to be used in commercial fertilizers accounts for the fact that the bulk of the ammonia recovered from byproduct-coke ovens goes into ammonium sulfate. The value of ammonia in relation to the total value of all byproducts has declined considerably from 1913, when 45 percent of the value of all byproducts was furnished by ammonia compared with 14 percent in 1941. This can be attributed to the development in recent years of more economical methods for the manufacture of ammonia. The 1941 production of ammonium sulfate totaled 1,490,395,760 pounds and exceeded the previous all-time high of 1,488,314,447 pounds produced in 1929. The value of ammonium sulfate, $0.013 per pound, exceeded the 1940 figure by $0.001 (table 50).

Light oil and its derivatives.—The derivatives of light oil are in acute demand by the war industries. Benzol is one of the major derivatives of light oil and is essential to the manufacture of so-called synthetic phenol. This in turn is required for the production of picric acid and is urgently needed as a high explosive and chemical warfare intermediate. Phenol is also essential in the manufacture of the phenol formaldehyde plastics used in our metal-substitution program and in the manufacture of nylon, a silk replacement. Benzol has wide application as a solvent and also as an ingredient in fuels for internal-combustion engines. Toluol is a basis of high explosive production when nitrated to di- and tri-nitrotoluol (TNT). The toluol used for making explosives is of very high quality and commands better prices than the industrial-grade toluol used as a commercial solvent. Xylol has many minor current demands as a relatively high boiling solvent and in many ways is being used to replace toluol. There was a substantial increase in the output of light oil and its derivatives in 1941 when compared with 1940. Receipts from the sales of light oil and its derivatives totaled $23,668,801 in 1941, an increase of $2,164,672 over the 1940 figure.

Naphthalene.—Naphthalene, another important byproduct derived from tar and light oil, is used in the manufacture of explosives, resins, and plasticizers. In addition, considerable quantities are used as a moth repellant for clothing. According to preliminary figures the output of naphthalene in 1941 totaled 83,810,422 pounds.

TABLE 46.—*Byproducts obtained from coke-oven operations in the United States in 1941* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales: Quantity	Sales: Value: Total	Sales: Value: Average	On hand December 31
Tar gallons	704,149,468	392,539,793	$18,386,170	$0.047	30,810,806
Ammonia:					
Sulfate pounds	1,490,395,760	1,513,137,970	19,708,646	.013	62,182,393
Ammonia liquor (NH_3 content) do	62,777,031	60,341,804	2,000,973	.033	1,513,180
			21,709,619		
Sulfate equivalent of all forms do	1,741,503,884	1,754,505,186			68,235,113
NH_3 equivalent of all forms do	435,375,971	438,626,297			17,058,778
Gas:					
Used under boilers, etc. M cubic feet	[2] 892,819,811	31,404,684	2,365,659	.075	
Used in steel or affiliated plants do		330,452,000	34,448,880	.104	
Distributed through city mains do		150,746,453	44,108,797	.276	
Sold for industrial use do		32,523,312	4,117,273	.127	
	[2] 892,819,811	554,126,449	85,040,609	.153	
Light oil and derivatives	(3)	(3)	23,668,801	(3)	(3)
Naphthalene, crude and refined pounds	[4] 83,810,422	(3)	(3)	(3)	(3)
Tar derivatives:					
Creosote oil, distillate as such gallons	38,283,662	39,205,666	4,583,327	.117	2,250,291
Creosote oil in coal-tar solution do	2,048,917	29,620	2,718	.092	6,820
Pitch of tar net tons	364,122	3,317	25,544	7.701	2,807
Tar acid oil gallons	11,675,741	11,794,218	1,359,242	.115	476,666
Other tar derivatives			1,584,966		
Pyridine, crude and refined gallons	277,285	280,036	286,230	1.022	23,250
Other byproducts [5]			2,161,958		
Value of all byproducts sold			[6] 158,809,184		

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol and other tar acids produced at Clairton, Pa.
[2] Includes gas wasted and gas used for heating ovens.
[3] Final figures withheld in accordance with Government policy. Preliminary production figures of benzol and toluol were 145,448,733 and 29,056,551 gallons, respectively.
[4] Preliminary figure.
[5] Ammonium thiocyanate, cyanogen, phenol, sodium phenolate, sodium prussiate, spent soda solution, sulfur, vented vapors, orthoxylene, dicycloentadiene, sal ammoniac, alpha picolene, and a small amount of miscellaneous products.
[6] Exclusive of value of breeze production, which was $9,530,433 in 1941.

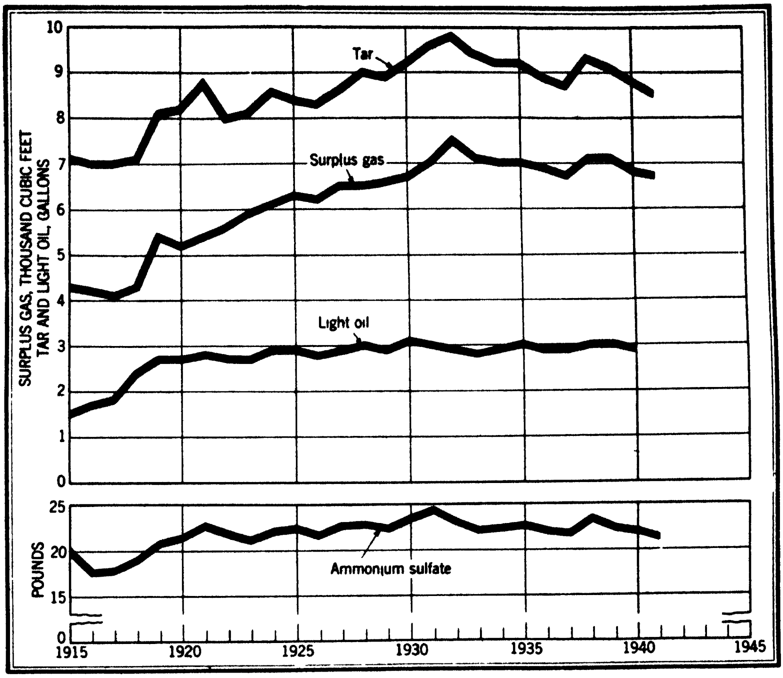

FIGURE 2.—Average yield of principal byproducts per net ton of coal carbonized in byproduct-coke ovens, 1915–41. Figures for light oil represent average at plants recovering light oil.

COKE-OVEN GAS

TABLE 47.—*Coke-oven gas produced and sold in the United States in 1941, by States*

State	Active plants	Produced (M cubic feet)	Used in heating ovens (M cubic feet)	Surplus sold or used: M cubic feet	Surplus sold or used: Value: Total	Surplus sold or used: Value: Average	Wasted (M cubic feet)
Alabama	8	72, 138, 690	32, 322, 941	38, 062, 387	$2, 891, 655	$0. 076	1, 753, 362
Colorado	1	11, 653, 997	5, 418, 698	6, 183, 840	(1)	(1)	51, 459
Illinois	9	51, 266, 854	15, 833, 576	34, 302, 467	5, 320, 341	. 155	1, 130, 811
Indiana	5	107, 611, 667	45, 242, 481	61, 091, 644	10, 436, 616	. 171	1, 277, 542
Maryland	1	22, 712, 519	9, 743, 916	12, 634, 670	(1)	(1)	333, 924
Massachusetts	2	18, 158, 357	4, 376, 487	13, 729, 276	(1)	(1)	52, 594
Michigan	8	43, 632, 491	5, 848, 674	37, 651, 284	4, 631, 924	. 123	132, 533
Minnesota	3	10, 794, 937	4, 259, 940	6, 397, 898	1, 573, 975	. 246	137, 099
New Jersey	2	16, 659, 986	3, 548, 732	13, 111, 254	(1)	(1)	----------
New York	8	77, 296, 493	19, 889, 135	56, 679, 891	16, 314, 656	. 288	727, 467
Ohio	15	136, 262, 944	58, 639. 069	74, 854, 313	8, 347, 042	. 112	2, 769, 562
Pennsylvania	12	253, 153, 398	103, 884. 214	148, 329, 055	17, 264, 504	. 116	940, 129
Tennessee	1	1, 424, 443	637, 047	787, 396	181, 180	. 230	----------
Utah	1	5, 288, 718	2, 247, 705	2, 813, 238	(1)	(1)	227, 775
West Virginia	5	32, 070, 426	9, 095, 951	22, 441, 409	1, 989, 017	. 089	533, 066
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	32, 693, 900	7, 148, 680	25, 056, 427	6, 102, 003	. 244	488, 793
Undistributed	------	----------	----------	----------	9, 987, 696	. 206	----------
Grand total, 1941	87	892, 819, 811	328, 137, 246	554, 126, 449	85, 040, 609	. 153	10, 556, 116
At merchant plants	42	201, 941, 491	47, 651, 668	151, 056, 932	38, 882, 342	. 257	3, 232, 891
At furnace plants	45	690, 878, 320	280, 485, 578	403, 069, 517	46, 158, 267	. 115	7, 323, 225
Grand total, 1940	85	833, 761, 720	297, 566, 103	523, 640, 555	81, 402, 047	. 155	12, 555, 062

[1] Included under "Undistributed."

TABLE 48.—*Disposal of surplus coke-oven gas in the United States in 1941, by States*

State	Used by producer—						Sold					
	Under boilers			In steel or other affiliated plants			Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value		M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
Alabama	6,887,757	$254,192	$0.037	23,177,871	$1,802,772	$0.078	5,668,016	$608,606	$0.107	2,328,743	$226,085	$0.097
Colorado				6,183,840	(1)	(1)						
Illinois	3.538,465	270,458	.076	5,228,752	760,655	.145	22,524,787	4,001,383	.178	3,010,463	287,845	.096
Indiana	4,433,699	349,181	.079	48.397,507	6,275,552	.130	6,918,744	3,324,806	.481	1,341,694	487,077	.363
Maryland	78,250	(1)	(1)	7,453,512	(1)	(1)	5,102,908	(1)	(1)			
Massachusetts	34,974	(1)	(1)	730	(1)	(1)	13,573,067	(1)	(1)	120,505	(1)	(1)
Michigan	1,432,344	160,489	.112	29,839,801	3,473,321	.116	2,873,072	504,733	.176	3,506,067	493,381	.141
Minnesota	796,012	45,113	.057	1,342,980	210,641	.157	4,258,906	1,318,221	.310			
New Jersey				463	(1)	(1)	13,110,791	(1)	(1)			
New York	2,962,546	234,286	.079	12,800,141	1,479,445	.115	38,243,243	14,202,990	.371	2,673,961	397,935	.149
Ohio	4,235,093	396,383	.094	58,242,546	5,816,794	.100	8,457,215	1,691,585	.200	3,919,459	442,280	.113
Pennsylvania	4,210,720	385,189	.091	117,335,310	11,340,876	.097	18,155,221	4,713,979	.260	8,627,804	824,460	.096
Tennessee	72,000	24,817	.345							715,396	156,363	.219
Utah	1,949,463	(1)	(1)	94,593	(1)	(1)	579,103	(1)	(1)	190,079	(1)	(1)
West Virginia	126,764	6,836	.054	20,353,954	1,669,177	.082				1,960,691	313,004	.160
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	646,597	62,845	.097				20,281,380	5,597,838	.276	4,128,450	441,320	.107
Undistributed		175,870	.085		1,619,647	.118		8,144,656	.252		47,523	.153
Grand total, 1941	31,404,684	2,365,659	.075	330,452,000	34,448,880	.104	159,746,453	44,108,797	.276	32,523.312	4,117,273	.127
At merchant plants	9,910,551	721,781	.073	8,042,159	731,947	.091	113,804,836	34,611,865	.304	19,299,386	2,816,749	.146
At furnace plants	21,494,133	1,643,878	.076	322,409,841	33,716,933	.105	45,941,617	9,496,932	.207	13,223.926	1,300.524	.098
Grand total, 1940	36.498,403	2,648,328	.073	305,890,735	31,171,675	.102	151,688,271	43,931,892	.290	29,563.146	3.650,152	.123

[1] Included under "Undistributed."

TAR

TABLE 49.—*Coke-oven tar produced and sold in the United States in 1941, by States*

State	Produced [1] (gallons)		Sold					Used by producer [3] (gallons)			On hand December 31 (gallons)
	Total	Per ton of coal coked	For use as fuel [2] (gallons)	For refining into tar products (gallons)	Total gallons	Value: Total	Value: Average	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
Alabama	56,506,001	8.49	6,546,500	27,164,498	33,710,998	$1,604,233	$0.048	536,234	21,078,644	269,091	3,335,138
Colorado	10,306,000	10.78		200,593	200,593	(4)	(4)		312,754	8,061	154,883
Illinois	38,218,193	7.43		31,575,550	31,575,550	1,449,096	.046		81,944		1,494,025
Indiana	59,111,084	5.85	1,406,338	35,071,827	36,478,165	1,602,657	.044		9,654,691	124,578	2,415,083
Maryland	18,976,866	7.86		20,071,073	20,071,073	(4)	(4)		29,587		191,461
Massachusetts	12,926,536	7.83	523,712	12,195,603	12,719,315	(4)	(4)				465,786
Michigan	32,622,795	8.12		34,197,057	34,197,057	1,525,493	.045		215,423		1,231,437
Minnesota	7,499,266	7.89		7,361,491	7,361,491	373,276	.051			13,704	516,859
New Jersey	11,849,132	8.23	3,571,966	8,349,492	11,921,458	(4)	(4)				642,460
New York	64,367,024	8.98	451,253	53,430,689	53,881,942	2,547,375	.047		6,229,275	1,360	2,868,213
Ohio	101,792,613	7.85	1,327	61,725,161	61,726,488	3,057,107	.050	2,365,591	37,055,503	280,010	2,950,097
Pennsylvania	229,170,465	10.03	2,114,861	28,140,430	30,255,291	1,384,711	.046	323,725	59,100,302	719,523	12,761,756
Tennessee	1,068,302	6.90		1,074,892	1,074,892	50,302	.047				23,862
Utah	4,464,200	11.24	157	4,443,619	4,443,776	(4)	(4)			2,400	177,954
West Virginia	31,745,557	11.05	133,160	29,059,634	29,192,794	1,453,778	.050		2,332,457		902,685
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	23,525,434	8.17		23,728,910	23,728,910	1,106,572	.047			2,340	679,107
Undistributed						2,231,570	.045				
Grand total, 1941	704,149,468	8.52	14,749,274	377,790,519	392,539,793	18,386,170	.047	3,225,550	136,090,580	1,401,067	30,810,806
At merchant plants	160,965,069	8.62	12,563,111	135,717,571	148,280,682	6,671,651	.045	1,520,892		107,190	6,203,885
At furnace plants	543,184,399	8.49	2,186,163	242,072,948	244,259,111	11,714,519	.048	1,704,658	136,090,580	1,293,877	24,606,921
Grand total, 1940	673,286,517	8.79	39,642,599	311,048,511	350,691,110	16,051,496	.046	3,215,363	172,738,403	1,408,990	43,317,247

[1] Includes 80,543,705 gallons of tar "refined at plant" and 103,653,501 gallons of tar "topped."
[2] Excludes 80,543,705 gallons of tar "refined at plant" and 103,653,501 gallons of tar "topped" that the Bureau of Mines is not at liberty to publish by States.
[3] Comprises 203,808 gallons of tar sold to affiliated corporations and 14,545,466 gallons sold to other purchasers.
[4] Included under "Undistributed."

AMMONIA

TABLE 50.—*Coke-oven ammonia produced and sold in the United States in 1941, by States*

State	Active plants	Sulfate equivalent of all forms (pounds)		Produced as—		Sold as—				On hand December 31 (pounds)	
		Total	Per ton of coal coked	Sulfate (pounds)	Liquor (NH_3 content) (pounds)	Sulfate		Liquor (NH_3 content)		Sulfate	Liquor (NH_3 content)
						Pounds	Value	Pounds	Value		
Alabama	8	164,301,444	24.68	139,381,188	6,230,064	140,170,109	$1,884,333	6,183,599	$230,963	1,002,787	174,387
Colorado	1	21,719,362	22.71	21,719,362		25,249,554	(1)			2,101,980	
Illinois	7	95,149,928	19.40	72,664,004	5,621,481	74,550,476	888,877	5,821,551	(1)	3,514,433	104,723
Indiana	5	166,309,982	16.46	143,705,142	5,651,210	147,022,400	1,786,605	5,818,563	(1)	11,806,194	192,963
Maryland	1	44,518,836	18.44	44,518,836		43,301,725	(1)			1,700,000	
Massachusetts	2	34,040,944	20.62	30,318,000	930,736	31,574,000	(1)	938,381	(1)	284,000	16,242
Michigan	8	88,411,537	22.02	33,173,617	13,809,480	33,248,770	(1)	12,015,010	265,807	2,394,756	312,289
Minnesota	3	19,592,252	20.61	19,592,252		20,623,457	259,658			2,150,971	
New Jersey	2	30,026,360	20.86	30,026,360		31,548,200	(1)			393,560	
New York	8	157,740,425	21.17	120,992,585	7,686,960	122,519,581	1,719,514	7,613,651	283,735	5,261,246	149,494
Ohio	15	270,673,594	20.89	227,171,390	10,875,551	233,232,496	2,929,372	9,772,037	346,819	3,857,228	231,610
Pennsylvania	11	522,401,649	22.96	516,902,093	1,374,889	520,133,552	6,720,166	1,466,424	(1)	25,559,935	12,245
Tennessee	1	3,229,401	20.87	3,229,401		3,108,000	43,778			174,647	
Utah	1	10,962,859	27.61	10,962,859		10,070,640	(1)			1,112,899	
West Virginia	3	56,009,707	25.20	56,009,707		56,435,050	806,746			218,514	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	62,415,604	21.95	20,028,964	10,596,660	20,349,960	275,449	10,712,588	380,910	649,243	319,227
Undistributed							2,394,148		492,739		
Grand total, 1941	81	1,741,503,884	21.34	1,490,395,760	62,777,031	1,513,137,970	19,708,646	60,341,804	2,000,973	62,182,393	1,513,180
At merchant plants	36	387,573,888	21.96	223,024,364	41,137,381	228,762,150	3,179,253	38,377,269	1,371,073	8,255,313	1,148,605
At furnace plants	45	1,353,929,996	21.17	1,267,371,396	21,639,650	1,284,375,820	16,529,393	21,964,535	629,900	53,927,080	364,575
Grand total, 1940	80	1,664,217,195	22.00	1,436,462,003	56,938,798	1,453,008,364	17,876,168	56,249,546	1,798,109	89,110,117	2,584,360

(1) Included under "Undistributed."

NAPHTHALENE

TABLE 51.—*Crude and refined naphthalene sold by byproduct-coke operators in the United States, 1937–41*

Year	Pounds	Value		Receipts per ton of coke (cents)
		Total	Average receipts per pound (cents)	
1937	60,315,581	$1,182,992	2.0	2.4
1938	25,456,400	437,654	1.7	1.4
1939	46,551,432	727,947	1.6	1.7
1940	72,522,476	1,248,051	1.7	2.3
1941	(1)	(1)	(1)	(1)

[1] Figures withheld in accordance with Government policy.

BYPRODUCT-COKE OVENS OWNED BY CITY-GAS COMPANIES (PUBLIC UTILITY PLANTS)

In city-gas plants more emphasis is placed upon the production of gas of proper analysis than upon the grade of coke made. However, with regard to the supply and demand for coke and byproducts, these installations belong to the byproduct-coke industry and are therefore included in the statistics supplied by the Bureau of Mines. The adaptability of byproduct ovens to the needs of city-gas manufacture has led a number of gas companies to install batteries of byproduct ovens to supplement or even replace coal or water-gas plants.

Sixteen byproduct plants owned by city-gas companies manufactured 3,403,374 tons of coke in 1941. This was an increase of 46,971 tons over 1940 and represented 6 percent of the byproduct-coke production of the country.

The following table presents salient statistics for 1940 and 1941 of the city-gas byproduct-coke plants in relation to the industry as a whole.

TABLE 52.—*Production of coke, breeze, gas, and byproducts in the United States at byproduct-coke plants owned by city-gas companies (public utilities) and at all other byproduct-coke plants, 1940–41*

Product	1940			1941		
	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities) [1]	Total	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities) [1]	Total
Number of active plants	69	16	85	71	16	87
Coke:						
Production ... net tons	50,657,906	3 356,403	54 014,309	55,079,048	3,403,374	58,482,422
Value	$238,125,557	$22,231,009	$260,356,566	$291,628,638	$24,848,593	$316,477,231
Average	$4.70	$6.62	$4.82	$5.29	$7.30	$5.41
Screenings or breeze:						
Production ... net tons	3,814,091	263,946	4,078,037	4,146,242	286,622	4,432,864
Sales ... do	565,942	37,715	603,657	804,324	31,835	836,159
Value	$1,285,916	$92,054	$1,377,970	$1,930,149	$84,411	$2,014,560
Average	$2.27	$2.44	$2.28	$2.40	$2.65	$2.41

See footnotes at end of table.

TABLE 52.—*Production of coke, breeze, gas, and byproducts in the United States at byproduct-coke plants owned by city-gas companies (public utilities) and at all other byproduct-coke plants, 1940–41*—Continued

Product	1940			1941		
	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities) [1]	Total	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities) [1]	Total
Coal charged into ovens:						
Quantity........net tons..	71,803,507	4,779,273	76,582,780	77,763,252	4,845,585	82,608,837
Coke:						
Used by producer:						
Quantity......net tons..	37,102,304	762,936	37,865,240	40,416,930	1,113,468	41,530,398
Value..................	$161,344,141	$4,786,314	$166,130,455	$196,417,684	$7,051,283	$203,468,967
Sales:						
Quantity......net tons..	14,102,810	2,777,113	16,879,923	14,747,208	2,403,881	17,151,089
Value..................	$80,485,357	$18,646,924	$99,132,281	$96,481,516	$18,619,617	$115,101,133
Byproducts:						
Gas:						
Production...M cu. ft..	778,583,598	55,178,122	833,761,720	836,747,586	56,072,225	892,819,811
Sales of surplus:						
Used under boilers:						
Quantity..M cu. ft..	36,457,763	40,640	36,498,403	31,368,112	36,572	31,404,684
Value..............	$2,641,776	$6,552	$2,648,328	$2,357,378	$8,281	$2,365,659
Used in steel or affiliated plants:						
Quantity..M cu. ft..	305,874,831	15,904	305,890,735	330,443,993	8,007	330,452,000
Value..............	$31,166,904	$4,771	$31,171,675	$34,446,478	$2,402	$34,448,880
Distributed through city mains:						
Quantity..M cu. ft..	103,034,048	48,654,223	151,688,271	110,054,651	49,691,802	159,746,453
Value..............	$25,180,149	$18,751,743	$43,931,892	$26,565,768	$17,543,029	$44,108,797
Sold for industrial use:						
Quantity..M cu. ft..	27,341,091	2,222,055	29,563,146	29,820,721	2,702,591	32,523,312
Value..............	$2,982,098	$668,054	$3,650,152	$3,293,920	$823,353	$4,117,273
Tar:						
Production.....gallons..	627,585,932	45,700,585	673,286,517	658,263,692	45,885,776	704,149,468
Sales:						
Quantity.........do....	304,117,805	46,573,305	350,691,110	345,358,272	47,181,521	392,539,793
Value..................	$13,880,054	$2,171,442	$16,051,496	$16,185,453	$2,200,717	$18,386,170
Average..............	$0.046	$0.047	$0.046	$0.047	$0.047	$0.047
Ammonia:						
Production (NH_3 equivalent of all forms) pounds..	391,415,668	24,638,631	416,054,299	410,834,145	24,541,826	435,375,971
Liquor (NH_3 content):						
Production..pounds..	53,322,055	3,616,743	56,938,798	59,596,924	3,180,107	62,777,031
Sales...........do....	52,659,414	3,590,132	56,249,546	57,167,866	3,173,938	60,341,804
Value..............	$1,732,850	$65,259	$1,798,109	$1,930,241	$70,732	$2,000,973
Sulfate:						
Production..pounds..	1,352,374,453	84,087,550	1,436,462,003	1,404,948,883	85,446,877	1,490,395,760
Sales...........do....	1,368,332,551	84,675,813	1,453,008,364	1,425,243,940	87,894,030	1,513,137,970
Value..............	$16,794,508	$1,081,660	$17,876,168	$18,499,497	$1,209,149	$19,708,646
Crude light oil:						
Production.....gallons..	211,282,923	3,930,744	215,213,667			
Sales.............do....	7,353,610	2,971,060	10,324,670	(2)	(2)	(2)
Value..................	$597,497	$231,534	$829,031			
Light oil derivatives:						
Production.....gallons..	177,134,556	660,075	177,794,631			(2)
Sales.............do....	166,955,002	603,432	167,558,434	(2)	(2)	(2)
Value..................	$20,586,693	$88,405	$20,675,098			[3] $23,668,801
Naphthalene, crude and refined:						
Production.....pounds..	71,914,774	511,669	72,426,443	(2)	(2)	[4] 83,810,422
Sales.............do....	71,994,045	528,431	72,522,476	(2)	(2)	(2)
Value..................	$1,240,402	$7,649	$1,248,051	(2)	(2)	(2)
All other byproducts, value..................	$5,120,569	$81,308	$5,201,877	$9,924,426	$79,559	$10,003,985

[1] Includes all byproduct ovens built by city-gas companies, some of which are operated in conjunction with coal, oil, and water-gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.
[2] Figures withheld in accordance with Government policy.
[3] Includes value of sales of both crude light oil and its derivatives.
[4] Preliminary figure.

FUEL BRIQUETS AND PACKAGED FUEL[1]

By G. S. Goodman

SUMMARY OUTLINE

The effect of the war was felt in both the fuel-briquet and packaged-fuel industries in 1941 through increased costs of raw materials and labor but far more seriously in the packaged-fuel industry where shortage of paper caused cancelation of a number of contracts for installations of machinery at new plants and resulted in the shut-down of 22 plants—some permanently. One manufacturer of briquetting machinery reported diversion of his business to the construction of special machines for briquetting ores and metal wastes for war work.

The world-wide reduction and dislocation of normal trade resulting from the war brought inquiries from Argentina for technical advice regarding the possibility of briquetting huge, unexportable surpluses of corn and corn husks to augment its reduced imports of coal and oil; and an American briquetting machine was shipped to the Institute of Technology at Rio de Janeiro, Brazil, to be tested in briquetting coal and other fuel materials—also in an effort to meet urgent fuel needs.

The fuel industry is keeping close watch on national developments in order to be prepared to meet all possible fuel requirements. Although the fuel-briquet industry in the past few years has been expanding gradually upon a sound basis in well-established markets, potential operators might well recall that during the World War of 1914–18 scarcity of other fuels created an unprecedented demand for briquets for domestic use, but that the Armistice found this country stocked with coal far exceeding its peacetime requirements. When munitions plants were closed, industrial demand receded, flooding the domestic market with coal for household use and reducing the market for fuel briquets more than one-third in 1919. Whether the coal trade will return to its former channels of consumption after the present war or will establish new foreign markets for United States production cannot be forecast at this time.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.
Data on employment and the principal expenses in the manufacture of fuel briquets may be obtained from the Bureau of the Census, which collects and publishes such data in alternate years; 1939 is the latest year for which such data have been collected.
Briquets made from charcoal, wood wastes, and fruit pits are not included in the Bureau of Mines review.

Fuel briquets produced in the United States reached an all-time high of 1,298,606 net tons in 1941—a 24-percent increase over 1940; the output of packaged fuel (considered separately in this report) amounted to 269,844 net tons—a 5-percent decrease from 1940. The combined output totaled 1,568,450 tons, valued at $10,473,396.

Records have been collected on the production of fuel briquets since 1907, when production was but 66,524 tons, with 11 plants in operation. Data on packaged fuel collected since 1935 show, for 1941, the first decline in production since its phenomenal record of growth.

Technologic developments.—Notwithstanding the war, the briquetting and packaged-fuel industries continued their research work in 1941 although a number of projects in the laboratory stage have been laid aside in favor of military work.

In the fall of 1941, V. F. Parry of the Technologic Branch, Bureau of Mines, Golden, Colo., began a technologic and engineering study of the fuel-briquetting and packaged-fuel industries, visiting about 35 operations. When additional plants are inspected the results of the study will be published.

Construction of the commercial-scale briquetting press designed by R. J. Piersol[2] at the Illinois State Geological Survey was completed in 1941, but final demonstrations on briquetting various Illinois coals have been postponed until sometime in 1942, owing to delays in delivery of necessary equipment because of war priorities.

In 1940 Dr. Piersol reported that deduster dust and sludges from many Illinois coals contain large quantities of fusain, which is relatively smokeless. When these dusts are briquetted the resulting fuel briquet is less smoky than average Illinois coal; if enough fusain is present, the briquets will meet the restrictions set up by the St. Louis smoke ordinance. During 1941 a major Illinois coal operator started large-scale production of briquets made of dust and screenings from mines and from a deduster plant in Franklin County, using a binder.

Komarek-Greaves & Co.,[3] of Chicago, Ill., is reported to be experimenting in the manufacture of briquets from low-volatile coal without binder, using a roll press that develops 30,000 to 40,000 pounds pressure per square inch. Although briquets made by this method are not as strong as briquets made with binder, they will stand handling and if bagged should make a satisfactory fuel.

A new, low-priced briquetting machine (with a capacity of about 70 tons per 24-hour day) to be used at docks, yards, and small coal mines for making pillow-shaped briquets to be sold in bulk was introduced in 1941 by the manufacturers of Eberling packaged-fuel machines. The product is said to be suitable for local truck delivery and storage in coal bins not exposed to the weather. The Smokeless Coal-Blox Co. plant in St. Louis[4] has been equipped with a machine of this type (as well as with several units of the Glenn-Smith type, making cubes).

[2] Piersol, R. J., Briquetting Illinois Coals Without a Binder by Compression and by Impact: Illinois State Geol. Survey Rept. of Investigations 31, 1933, 70 pp.; Briquetting Illinois Coals Without a Binder by Impact: Illinois State Geol. Survey Rept. of Investigations 37, 1935, 75 pp., Smokeless Briquets; Impacted Without Binder from Partially Volatilized Illinois Coals: Illinois State Geol. Survey Rept. of Investigations 41, 1936, 30 pp.; The Smoke Index: Coal Heat, vol. 39, No. 2, 1941, pp. 59–60, Study Illinois Coals: Coal Heat, vol. 40, No. 3, 1941, p. 16.

[3] Briquetting engineers; manufacturers of equipment installed at about two-thirds of the plants active in 1941.

[4] Black Diamond, St. Louis News Notes: Vol. 107, No. 11, 1941, p. 43.

The new packaged-fuel process and machinery developed by the Viking Machinery Co., Jackson, Mich., are discussed under Processes in the Packaged Fuel section of this report.

A new plant—Coal Logs Co., Inc., of Salt Lake City—to process Utah coals without binder and reported to produce a 100-percent smokeless fuel is scheduled for operation in April 1942.[5] Test work during the past 2 years is said to have proved successful.

FUEL BRIQUETS

The salient statistics of the fuel-briquetting industry from 1937 to 1941 are summarized in the following table (data on imports and exports during the last quarter of 1941 are not available for publication). Detailed data for earlier years, beginning with 1907, are to

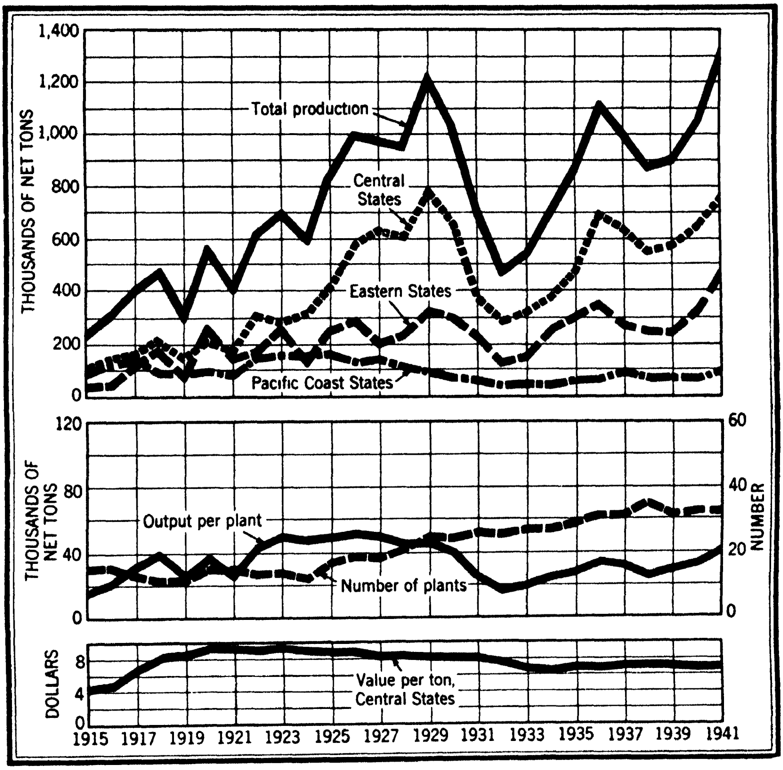

FIGURE 1.—Production of fuel briquets, number of plants in operation, and average value per ton, f. o. b. plant (Central States), 1915–41.

be found in annual issues of Mineral Resources (part II) and Minerals Yearbook, which include chapters on briquetting. Production and value from 1915 to 1941, inclusive, are presented graphically in figure 1 of this report.

[5] Salt Lake City Tribune, Plant Prepares to Make Smokeless Fuel: December 23, 1941.
Coal Age, To Make Utah Coal Smokeless: Vol. 47, No. 2, 1942, p. 118; Coal Logs Plant to Open Soon: Vol. 47, No. 4, 1942, pp. 125–126.

Salient statistics of the fuel-briquetting industry in the United States, 1937–41

[Data regarding packaged fuel are given separately at end of this chapter]

Year	Production: Eastern States	Production: Central States	Production: Pacific Coast States	Production: Total	Imports	Exports[1]	Consumption[2]	Value of production (thousands of dollars)	Plants in operation	Average output per plant (thousands of net tons)	Average value per net ton, f. o. b. plant: Eastern States	Average value per net ton, f. o. b. plant: Central States	Average value per net ton, f. o. b. plant: Pacific Coast States
	Thousands of net tons												
1937	271	636	89	996	7	25	978	6,394	31	32	$4.19	$7.01	$8.94
1938	251	546	74	871	14	17	868	5,702	35	25	4.34	7.18	9.38
1939	243	574	75	892	1	13	880	5,802	31	29	4.23	7.15	8.96
1940	331	652	68	1,051	------	23	1,028	6,439	32	33	3.95	6.95	8.84
1941	458	752	89	1,299	(3)	[4] 27	[4] 1,272	8,002	32	41	4.21	7.09	8.36

[1] Exports reported separately by Department of Commerce beginning with 1937.
[2] Production plus imports minus exports.
[3] Imports for January to September, inclusive, totaled 108 tons.
[4] Figures for imports and exports cover January to September, inclusive.

Production.—The output of fuel briquets in 1941—1,298,606 net tons valued at $8,001,829—topped all previous records and represented a 24-percent increase in both tonnage and value over 1940. The increased activity in 1941 is directly traceable to efforts to meet increased fuel demands in the national emergency. If operated at its full present capacity, the industry could more than double its 1941 production. An active promotional campaign by the operators [6] has seemed to stimulate both production and sales.

Briquets were produced in 17 States. Almost half of the entire output was concentrated in Wisconsin; West Virginia and Pennsylvania followed in order, with large increases. Other States producing over 20,000 tons were, in order of importance, Oregon, Missouri, Illinois, Minnesota, North Dakota, and Michigan. Increased production was reported in all but 6 States.

Packaging of bulk briquets at the plants, amounting to 37,000 tons, was reported by 17 fuel-briquet operators; no data are available on the quantity of briquets packaged by retailers.

Production of fuel briquets in the United States, 1940–41

	1940: Plants	1940: Net tons	1940: Value	1941: Plants	1941: Net tons	1941: Value	1941: Percent of increase over 1940 in—Tonnage	1941: Percent of increase over 1940 in—Value
Eastern States	4	330,985	$1,308,789	4	457,511	$1,926,048	38.2	47.2
Central States	23	651,880	4,529,114	23	751,801	5,329,408	15 3	17.7
Pacific Coast States	5	68,005	601,049	5	89,294	746,373	31.3	24.2
	[1] 32	1,050,870	6,438,952	[1] 32	1,298,606	8,001,829	23.6	24.3

[1] 1940: 11 plants in Wisconsin; 2 each in California, Minnesota, Nebraska, Washington, and West Virginia; and 1 each in Arkansas, Illinois, Massachusetts, Michigan, Missouri, North Dakota, Ohio, Oregon, Pennsylvania, Texas, and Wyoming. 1941: 10 plants in Wisconsin; 2 each in California, Illinois, Michigan, Nebraska, Washington, and West Virginia; and 1 each in Arkansas, Massachusetts, Minnesota, Missouri, North Dakota, Ohio, Oregon, Pennsylvania, Texas, and Wyoming.

[6] Coal Dealer, Biggest Stott Briquet Sales and Advertising Promotion Set for 1941–42 Season: Vol. 38, No. 5, 1941, p. 57; Berwind Anticipating Big Year: Vol. 38, No. 5, 1941, p. 49; United Briquets Growing in Popularity: Vol. 38, No. 5, 1941, p. 52.
Black Diamond, Binkley Entertains Kansas City Retailers: Vol. 107, No. 3, 1941, p. 37; Water-borne Shipments of Berwind Briquets: Vol. 107, No. 12, 1941, p. 30.

Large tonnages of bituminous coal moving over the Great Lakes during the summer months are stored at Lake ports. During the winter months, when the Lakes are closed, the coal is reloaded and shipped into the Northwest. The fine coal resulting from rehandling has a lower sales value than the coarser sizes, but a higher-grade product can be made by briquetting and a better sales realization obtained. The enormous supplies of bituminous slack thus made available at Lake ports has naturally made Wisconsin the nucleus of the briquetting industry. It is the only State for which production can be shown without revealing data on individual operations.

Production of fuel briquets in Wisconsin, 1936–41

Year	Plants	Net tons	Value	Year	Plants	Net tons	Value
1936	9	588, 163	$4, 178, 981	1939	10	430, 554	$3, 158, 859
1937	10	507, 462	3, 639, 183	1940	11	487, 574	3, 440, 676
1938	10	422, 281	3, 085, 873	1941	10	535, 457	3, 870, 077

There are other large plants located at coal mines, principally in West Virginia and Pennsylvania, and smaller operations at petroleum refineries and gas plants, mainly in the Pacific Coast area.

Briquets are used almost entirely for househeating; therefore, production is normally highly seasonal. In 1941, production was lowest in April, but in June—months earlier than usual—operations stepped up markedly, reaching their peak in November. Twenty of the 32 active plants operated every month of the year and only 3 less than 6 months.

According to the Weather Bureau,[7] the winter was slightly colder than normal in parts of the Atlantic coast, but in all other sections—including the North Central States, where the bulk of the consumption of briquets is concentrated—above-normal warmth prevailed.

Monthly production of fuel briquets in the United States, 1939–41, in net tons

Month	1939	1940	1941	Month	1939	1940	1941
January	113, 698	157, 091	135, 532	August	57, 267	58, 706	109, 487
February	99, 195	76, 550	118, 596	September	78, 012	84, 466	107, 257
March	58, 840	68, 981	85, 728	October	113, 315	92, 295	120, 197
April	34, 001	43, 936	27, 252	November	89, 465	128, 301	143, 339
May	51, 384	66, 449	82, 723	December	83, 579	140, 133	137, 166
June	71, 273	57, 814	105, 307				
July	42, 184	76, 148	126, 022		892, 213	1, 050, 870	1, 298, 606

Value.—Sales realizations on briquets in the widely separated producing centers in a given year vary considerably. An average value per ton for the entire industry therefore has doubtful significance because conditions under which briquets are manufactured differ in various parts of the country. The most important factors that influence the value per ton realized at any plant probably are the cost of raw materials, labor, and the price of competing fuels; hence, the general trend of fuel-briquet prices in the past 5 years is indicated best in this review by the average values in the Eastern, Central, and Pacific Coast States, as shown in the last three columns of the

[7] Mattice, W. A., The Weather of 1941 in the United States: U. S. Dept. of Agriculture Monthly Weather Rev., vol. 69, No. 12, December 1941, pp. 360–361.

first table of this chapter. These figures are not the prices paid by the consumers. Some plants are far from the markets they serve, and transportation charges and the margin of the wholesaler or retailer —sometimes both—must be added to the value at the plant.

The total value of fuel briquets manufactured in 1941 was $8,001,829 f. o. b. plant—an increase of $1,562,877 (24 percent) compared with 1940.

In the eastern part of the country the average value of $4.21 per ton is relatively low because virtually all the output comes from plants in the low-volatile bituminous fields of West Virginia and in the anthracite region of Pennsylvania, where the freight charges are not so important an item in the cost of raw fuel. In the Central States most of the raw fuel (bituminous low-volatile and Pennsylvania anthracite) comes from Lake docks, and the average value of $7.09 per ton discloses the extent to which freight charges affect value. In the Pacific Coast States, where residual carbon from the manufacture of oil gas forms the greater part of the raw fuel used, the average value dropped from $8.84 in 1940 to $8.36 in 1941.

Prices.—The following monthly fuel-briquet prices,[8] by cities, for 1941 are based upon cash delivery in 1-ton (2,000-pound) lots for retail sales to household consumers at the curb or into the customer's bin (without extra handling or additional charge).

Retail fuel-briquet prices per net ton, by cities, in 1941 [1]

City and State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Baltimore, Md	$9.75	$9.75	$9.75	$9.75	$9.75	$9.82	$10.50	$11.00	$11.00	$11.00	$11.00	$11.00
Boston, Mass	12.50	12.50	12.50	12.50	12.50	12.22	13.25	13.25	13.75	13.75	13.75	13.75
Charleston, S. C	13.33	13.33	13.33	13.33	13.33	13.33	11.33	14.08	14.08	14.08	14.08	14.08
Chicago, Ill	11.65	11.65	11.65	11.65	11.71	11.71	11.89	11.96	11.96	12.21	12.21	12.21
Cincinnati, Ohio	8.56	8.56	8.56	8.56	8.50	8.50	8.88	9.27	9.27	9.40	9.40	9.40
Columbus, Ohio	8.39	8.39	8.39	8.39	8.39	8.39	8.76	8.93	9.34	9.63	9.63	9.63
Fall River, Mass	12.50	12.50	12.50	12.50	12.50	12.50	13.00	13.15	13.75	13.75	13.75	13.75
Kansas City, Mo	9.69	9.69	9.69	9.69	9.69	9.56	10.05	10.05	10.05	10.05	10.05	10.05
Los Angeles, Calif	17.00	17.00	17.20	17.10	16.89	16.89	16.89	18.09	18.41	19.12	19.18	19.43
Louisville, Ky	8.00	8.00	8.00	8.00	8.00	8.15	8.25	8.45	8.75	8.70	8.70	8.70
Manchester, N. H	12.75	12.75	12.75	12.75	12.75	13.00	13.00	13.50	13.50	14.00	14.00	14.00
Milwaukee, Wis	10.90	10.90	10.90	10.90	10.89	10.80	10.86	11.27	11.27	11.77	11.77	11.77
Minneapolis, Minn	12.80	12.80	12.80	12.80	12.32	12.45	12.70	12.95	13.05	13.05	13.05	13.05
Norfolk, Va	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.00	11.00	11.50	11.50	11.50
Providence, R. I	11.97	11.88	11.88	11.88	11.88	12.13	12.13	12.13	12.13	12.13	12.13	12.13
Richmond, Va	10.50	10.50	10.50	10.50	10.00	10.00	10.50	10.50	11.17	11.17	11.17	11.42
St. Louis, Mo	9.95	9.95	9.95	9.95	9.95	9.90	10.12	10.39	10.47	12.62	10.80	10.80
St. Paul, Minn	12.80	12.80	12.80	12.80	12.40	12.48	12.70	12.95	13.05	13.05	13.05	13.05
San Francisco, Calif	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	21.63	21.63
Seattle, Wash	13.90	13.90	13.90	13.39	13.52	13.65	13.78	13.90	13.90	14.29	14.29	14.29
Washington, D. C	11.05	11.05	11.05	11.05	11.05	11.05	11.25	11.38	11.38	11.50	11.50	11.50

[1] From monthly reports, Retail Fuel Prices by Cities, Retail Price Division, Bureau of Labor Statistics.

Number of plants.—Thirty-two plants reported commercial production in 1941; all but 2 of these (the new briquetting plant of the Coal Processing Corporation at Buckner, Ill.,[9] and that of the Scheele Coal Co. at Jackson, Mich.) were also active in 1940. Seven plants were idle in 1941; of these all but one were also idle in 1940. One idle plant—the Kleen Blox Coal Co., at Dickinson, N. Dak., which reported experimental production in 1938 and none since—went out of business. Two new plants (in Illinois and Missouri) were reported under construction in 1941, with operations to start in 1942. Of the

[8] From monthly reports, Retail Fuel Prices by Cities, Retail Price Division, Bureau of Labor Statistics.
[9] Black Diamond, St. Louis News Notes: Vol. 106, No. 12, 1941, p. 46.

five reported as under construction in 1940 to start in 1941, only one—that of the Coal Processing Corporation at Buckner, Ill.—began commercial operations in 1941.

Size of plants.—The following table classifies the plants operating in 1940–41 according to actual production as well as actual capacity; however, capacity affords a better indication of the size of the plants.

The total annual capacity of the 32 plants active in 1941, obtained from the operators' reports, is about 3,100,000 net tons. It is interesting to note that, although the industry reached an all-time high in 1941, should the demand warrant these 32 plants could provide more than twice their 1941 production.

The average output of the individual plants increased 24 percent—from 33,000 tons in 1940 to 41,000 in 1941. Twenty plants that operated every month in 1941 produced 1,074,811 tons—83 percent of the total.

Classification of briquetting plants in the United States, 1940–41, by size of output and annual capacity

Output (net tons)	Plants 1940	Plants 1941	Annual capacity (net tons)	Plants 1940	Plants 1941
Less than 2,000	5	6	Less than 5,000	2	2
2,000 and less than 5,000	5	2	5,000 and less than 10,000	2	4
5,000 and less than 10,000	3	3	10,000 and less than 25,000	7	6
10,000 and less than 25,000	8	9	25,000 and less than 100,000	13	11
25,000 and less than 100,000	6	6	100,000 and less than 200,000	4	5
100,000 and over	5	6	200,000 and less than 400,000	2	2
			400,000 and over	2	2
	32	32		32	32

Raw fuels.—The number of plants, by type of fuel used in 1941, is shown below.

Classification of fuel-briquetting plants in the United States in 1941, by kinds of raw fuel used

Kind of raw fuel used:	Plants
Anthracite and semianthracite fines exclusively	5
Mixture of Pennsylvania anthracite and bituminous	5
Bituminous:	
Low-volatile	13
High-volatile	3
Lignite	1
Semicoke (lignite char)	1
Residual carbon from pyrolysis of natural gas	1
Residual carbon from manufacture of oil gas	2
Petroleum coke	5
	[1] 36

[1] 3 plants made 2 kinds and 1 plant 3 kinds of briquets; hence the sum of these items exceeds the total number of plants.

A considerable quantity of Illinois bituminous high-volatile slack is used as raw fuel at the new briquetting plant of the Coal Processing Corporation at Buckner, Ill. It is also noteworthy that the quantity (though relatively small) of residual carbon from pyrolysis of natural gas, used at a California briquetting plant, doubled in 1941. Petroleum coke is being used increasingly in the manufacture of briquets.[10]

[10] Coal Dealer. Carbo Cok-ette Plant Running Full Blast: Vol. 38, No. 5, 1941, pp. 50–51.

The Consumers Lignite Co. at Alba, Tex.,[11] using raw Texas lignite without charring in making briquets, began to operate commercially in 1940 and also reported a small tonnage in 1941.

Raw fuels used in making fuel briquets in the United States, 1940–41

Raw fuel	Net tons		Percent of total	
	1940	1941	1940	1941
Anthracite and semianthracite culm and fine sizes	222,618	265,637	22.2	21.6
Bituminous and subbituminous slack [1]	636,312	787,722	63.4	64.1
Residual carbons from oil-gas manufacture and natural-gas pyrolysis; petroleum coke; and semicoke (lignite char)	144,167	175,043	14.4	14.3
	1,003,097	1,228,402	100.0	100.0

[1] Includes small tonnage of Texas lignite used without charring.

Seven operators reported washing their raw fuel (totaling 269,927 tons) before manufacturing it into briquets.

In 1941, as in 1940, four operations reported making more than one kind of briquet. One in Nebraska made three kinds in 1941 (petroleum coke, semianthracite, and low-volatile bituminous cubes); another in Nebraska made two kinds of cubes from petroleum coke and semianthracite. A large Wisconsin operator made small pillow briquets from a mixture of Pennsylvania anthracite and low-volatile bituminous coal as well as from low-volatile bituminous coal exclusively. The fourth, a Missouri operator, made two kinds of pillow briquets from the hard coals of Arkansas.

Production of fuel briquets, 1940–41, with reference to sources of raw fuels used

Location of plant	Net tons		Percent of increase in 1941
	1940	1941	
At or near Lake Superior or Lake Michigan coal docks	511,336	532,728	4.2
At coal mines	414,490	539,223	30.1
At or near petroleum refineries and oil- and natural-gas plants	111,667	141,405	26.6
At other locations [1]	13,377	15,046	12.5
	1,050,870	1,228,402	16.9

[1] Fall River, Mass.; Jackson, Mich.; and Omaha, Nebr.

Binders and recarbonization.—As the following table indicates, asphaltic pitch is the preferred binder in briquetting coal and coke. An approximate total of 80,000 tons of asphaltic pitch and 2,300 tons of starch and smaller amounts of other binders were used in the manufacture of fuel briquets in 1941.

Of the three plants using no binder, two briquetted the carbon residue from the manufacture of oil gas and one used low-volatile bituminous coal. The last, which has been in operation since 1936, manufactures 3¾-ounce pillow briquets by impact; capacity of the plant is about 1½ tons per hour and impact pressures of 50,000 to 60,000 pounds per square inch are obtained; the entire production is consumed locally.

[11] Coal Age, Texas Lignite Mine—Develops Method of Briquetting in Struggle for Markets vs. Gas and Oil: Vol. 46, No. 11, 1941, p. 51.

No operators in 1940 or 1941 reported recarbonization of briquets to drive off smoke after leaving the presses. Whether the finished product will be of the smoky type or not depends primarily on the type of raw fuel used; if the raw fuel is smoky, the briquet will be also.

Classification of briquetting plants in the United States in 1941, by type and percentage of binder used

Type of binder	Plants	Production: Net tons	Production: Percent of total	Ratio of binder to raw fuel (by weight)	Plants	Production: Net tons	Production: Percent of total
Asphaltic pitch	[1] 24	1,024,902	78.9	Less than 5 percent	4	165,194	12.7
Mixed pitches	2			5 and less than 7 percent	13	438,852	33.8
Asphalt and starch	1	200,087	15.4	7 and less than 9 percent	10	620,943	47.8
Starch	2			9 percent and over	2		
No binder	[2] 3	73,617	5.7	No binder	[2] 3	73,617	5.7
	32	1,298,606	100.0		32	1,298,606	100.0

[1] One plant also uses a nearly equal amount of unspecified binder.
[2] Two plants use residual carbon from manufacture of oil gas, and 1 uses bituminous coal as raw fuel.

Weight and shape.—Pillow-shaped briquets predominate in the United States. Of the total production in 1941, 26 of the 32 active plants produced 921,310 tons (71 percent) of pillow-shaped briquets; with one exception—the new plant of the Coal Processing Corporation at Buckner, Ill., which makes so-called "Fireballs" weighing 11 ounces each—these pillow briquets weigh from 1¾ to 5 ounces. Three plants produced 359,395 tons (28 percent) of cylindrical type and three plants 17,901 tons (about 1 percent) of cube-shaped briquets.

According to reports received, only one plant made briquets in more than one shape in 1941—an operator in Wisconsin who produced a square-pillow type of a mixture of Pennsylvania anthracite and bituminous low-volatile and a modified-pillow type of bituminous low-volatile.

Two plants made two sizes—one in Nebraska made a 20-ounce petroleum-coke cube, and a 24-ounce semianthracite cube as well as a 24-ounce bituminous low-volatile cube; the other in Wisconsin (the plant referred to above) made a Pennsylvania-anthracite and bituminous low-volatile pillow briquet (2 by 2 by 1¼ inches) and a bituminous low-volatile modified-pillow briquet (2 by 1½ by 1¼ inches).

Prevailing weight of briquets produced in the United States in 1941

Weight (ounces)	Plants	Production: Net tons	Production: Percent of total	Weight (ounces)	Plants	Production: Net tons	Production: Percent of total
Less than 2	4	67 [illegible]	5.2	6 and under 10			
2 and under 3	13	744,[illegible]	57.3	10 and under 16	1	50,414	3.9
3 and under 4	6	347,083	26.7	16 and under 25	3		
4 and under 5	4	89,294	6.9		32	1,298,606	100.0
5 and under 6	1						

Distribution.—Shipments of briquets during 1941, as reported by the operators, increased 22 percent over 1940. Briquets are used widely in the United States; in 1941 they were shipped into 39 States, the District of Columbia, and Alaska and exported to other countries.[12]

Shipments from each producing State cannot be shown because there are only one or two producers in each of the States except Wisconsin and confidential reports of individual companies would thus be revealed. However, a graphic presentation of the centers of production with corresponding States of destination for 1928 and 1936 is included in Minerals Yearbook, 1937 (p. 965, fig. 65).

Shipments by truck in the Central States increased in 1941. Generally, rail movement represents shipments to considerable distances and shipment by truck represents local and nearby consumption.

Shipments of fuel briquets of domestic manufacture, 1940–41, by States of destination, in net tons

State	1940	1941	State	1940	1941
Alaska	94	2,213	Nebraska	25,371	23,992
Arkansas	150	256	New Hampshire	2,412	3,210
California	9,798	14,075	New Jersey	1,176	871
Connecticut	1,059	844	New York	26,091	25,141
Delaware	250	208	North Carolina	12,770	13,203
District of Columbia	423	248	North Dakota	66,114	80,136
Florida	671	591	Ohio	49,722	67,822
Georgia	159	238	Oklahoma	24	43
Idaho	33	------	Oregon	29,378	32,414
Illinois	31,895	50,398	Pennsylvania	10,272	14,186
Indiana	25,946	45,934	Rhode Island	3,793	3,843
Iowa	25,509	31,608	South Carolina	3,820	4,798
Kansas	5,145	4,957	South Dakota	60,723	64,026
Kentucky	5,635	5,734	Tennessee	35	------
Louisiana	77	48	Texas	590	178
Maine	6,113	4,828	Vermont	190	238
Maryland	2,073	2,969	Virginia	17,638	18,187
Massachusetts	38,324	38,756	Washington	20,359	42,977
Michigan	77,513	107,217	West Virginia	488	339
Minnesota	217,068	244,767	Wisconsin	230,840	220,939
Missouri	16,738	82,954	Wyoming	1,646	1,576
Montana	50	22		1,028,175	1,256,964

Shipments of fuel briquets by rail and truck, 1940–41, in net tons

Produced in—	1940			1941		
	Rail	Truck [1]	Total	Rail	Truck [1]	Total
Eastern States	325,175	4,855	330,030	447,458	8,428	455,886
Central States	489,793	167,255	657,048	569,295	181,849	751,144
Pacific Coast States	18,087	40,679	58,766	38,377	54,184	92,561
Total United States	833,055	212,789	1,045,844	1,055,130	244,461	1,299,591

[1] Includes local deliveries.

Imports and exports.—Before 1922 the quantity of fuel briquets imported into the United States was negligible. The anthracite shortages of 1922–23 and 1925–26, however, created a demand for the European product (mostly from Germany, Belgium, and France, and mainly for consumption in the anthracite-consuming States), which in 1926 reached a record of 123,593 net tons. Imports continued at a comparatively high level in the following years; in 1932 they amounted to 80,288 tons but thereafter dropped sharply and since September 1939 have virtually ceased, the last overseas shipment (1,344 net tons), from Belgium to Massachusetts, arriving in February 1939. The

[12] See table of exports for quantities exported.

only record of imports since 1939 covers a shipment of 108 tons from Canada to Alaska in 1941.

Figures for imports of briquets since 1919, the first year of record, are included in annual volumes of Mineral Resources and Minerals Yearbook.[13]

Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1937–41

Year	Net tons	Value	Year	Net tons	Value
1937	6,674	$28,549	1940		
1938	13,814	67,366	1941 (Jan.-Sept.)	108	$548
1939	1 344	5,752			

Briquets (coal and coke) exported from the United States, 1937–41 [1]

Year	Net tons	Value	Year	Net tons	Value
1937	25,350	$166,369	1940	23,285	$161,619
1938	16,692	123,309	1941 (Jan.-Sept.)	27,301	199,351
1939	12,576	97,725			

[1] Data for 1937–40, by countries and customs districts, shown in earlier reports of this series.

World production.—Official data on production of fuel briquets in other countries since 1939 have been meager, owing to the war. Any possible revisions will be made in forthcoming issues of this series.

World production of fuel briquets, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Algeria	68,682	(2)	(2)	(2)	(2)
Australia: Victoria [3]	396,760	420,704	421,254	(2)	(2)
Belgium	1,849,280	1,712,280	1,561,210	(2)	(2)
Bulgaria	47,106	85,770	88,496	100,000	(2)
Czechoslovakia:					
Coal	459,680	(2)	(2)	(2)	(2)
Lignite	264,482	(2)	(2)	(2)	(2)
Eire (Irish Free State)	10,725	20,501	(2)	5,337	(2)
France	8,321,000	7,475,000	(2)	(2)	(2)
Germany:					
Coal	6,785,537	6,897,245	(2)	(2)	(2)
Lignite	41,951,141	44,007,268	(2)	(2)	(2)
Hungary	373,519	441,081	(2)	(2)	(2)
Indochina	132,225	131,558	185,400	114,000	(2)
Italy	58,860	51,047	(2)	(2)	(2)
Netherlands:					
Coal	1,277,305	1,262,716	1,268,926	(2)	(2)
Lignite	49,539	60,543	68,607	(2)	(2)
Netherlands Indies	55,349	82,123	85,079	99,315	(2)
New Zealand	31,582	29,947	29,889	28,529	(2)
Poland	209,347	222,531	(2)	(2)	(2)
Portugal	7,772	19,865	(2)	(2)	(2)
Rumania	262,330	232,662	(2)	(2)	(2)
Spain	342,000	568,000	765,000	785,000	[4] 178,000
Tunisia	82,805	86,478	(2)	(2)	(2)
Turkey	14,761	37,285	14,792	24,497	(2)
United Kingdom	826,600	507,415	(2)	(2)	(2)
United States [5]	1,035,970	936,402	1,004,902	1,211,433	1,422,866
Yugoslavia	61,323	100,945	132,466	(2)	(2)
Total [6]	64,975,680	65,389,366	(2)	(2)	(2)

[1] In addition to the countries listed, briquets are produced in Canada and New Caledonia, but data on output are not available.
[2] Data not available.
[3] Data for year ended March 31 of year stated.
[4] January to June, inclusive.
[5] Includes packaged fuel as follows—1937: 132,482 tons; 1938: 146,012 tons; 1939: 195,504 tons; 1940: 258,105 tons; 1941: 244,797 tons.
[6] Totals incomplete; they represent sum of figures given in table only.

[13] 1919–29, Mineral Resources, 1929, part II, p. 32; 1930–35, Minerals Yearbook, 1936, p. 657; 1936, Minerals Yearbook, 1937, p. 964.

PACKAGED FUEL

Packaged fuel differs from fuel briquets in that the former is a more or less friable product wrapped to withstand weathering and breakage and designed primarily for local or nearby consumption. The packages, tightly wrapped in heavy paper and sealed with gummed tape, consist of 3- to 4-inch cubes (six to a package, weighing 10 to 15 pounds). Packaged fuel is made from various types of high-quality coal or coke screenings, usually mixed with a neutral binder. Its growth in popularity has been due largely to convenience and cleanliness in handling and to the fact that it may be purchased in less-than-ton lots. The output of packaged fuel, which rose so rapidly from 1935 to 1940, dropped in 1941 for the first time and was 5 percent less than in 1940, amounting to 269,844 tons valued at $2,471,567 in 1941.

The war is seriously affecting the packaged-fuel industry. The increased cost of raw fuels and labor and the shortages of paper, glue, etc., as well as competition within the industry itself, have reduced production at many plants and forced a number of others out of business. Machinery manufacturers reported virtual stoppage of sales for new installations in the summer and fall of 1941. One reported that five orders for installation of completely automatic packaged-fuel machines were canceled in the United States and two in Canada because paper supplies were not available; and another reported diversion of his business to construction of special machines for briquetting ores and metal wastes for war work. Over 2 million pounds of paper were required to wrap the packaged fuel produced in 1941. However, it is believed that, if paper requirements can be even partly met, the industry will continue to operate during the emergency, because clean packaged fuel has proved attractive to many consumers.

The record of 62 plants, which began operations between 1935 and 1938 and were active each year through 1941, would indicate definitely that the industry was firmly established before the paper shortage. There seems to have been a gradual trend toward fewer but larger plants to reduce costs; but smaller units probably will continue to operate in isolated sections.

Of the operators producing packaged fuel in 1941, one-third reported wrapping their product by machine, one-third by hand, and one-third partly by machine and partly by hand.

Although packaged fuel is manufactured principally for local or nearby consumption, in 1941 eight operators reported shipping 4,399 tons by rail and 11,382 tons by truck within a radius of 500 miles.

Processes.—No new processes or types of machinery for use in the packaged-fuel industry were reported by United States operators in 1941. Eighty manufacturers used the Eberling process [14] in 1941; others used the Glenn-Smith [15] and Leemon [16] processes; and one—the Johnson Coal Cubing Co.,[17] of Detroit, Mich., largest operator since 1932—uses a process and equipment of its own design. These

[14] Eberling, C. M., Packaged Fuel by the Eberling Process: 1938 Catalog, 6002 Ellen Ave., Cleveland, Ohio.
[15] Black Diamond, Briquetting Plant Solves Slack Problem: Vol. 98, No. 6, March 13, 1937, p. 60.
[16] Black Diamond, vol. 102, No. 12, June 17, 1939, p. 15.
[17] Black Diamond, A Mammoth Package Fuel Plant: Vol. 102, No. 7, April 8, 1939, p. 23.

processes are discussed in earlier reports of this series and in the trade journals.

In 1941, several packaged-fuel plants using the "cold-mix" method started fluxing briquetting mixtures with live steam to improve the binding properties of starch and to increase the rate of drying the finished packages, and some have reported favorable results.[18]

In 1939 the Viking Machinery Co. of Jackson, Mich., developed a process and machine for making packaged fuel, which comprises the manufacture of binder from off-grade grains at the briquetting plant, hot mixing of this prepared grain binder with the coal, making the cubes by mechanical vibration and tamping action and automatically wrapping the cubes. The entire operation except the transfer of the wrapped cubes to the drying conveyor is automatic. The Consolidation Coal Co., Windsor, Ontario, is reported to be successfully operating these machines 24 hours a day and to be unable to supply the demand. The plant is significant in that it, along with a few others in the United States, indicates a trend toward well-engineered packaged-fuel plants of greater capacity rather than small plants in retail yards. No plants in the United States are at present equipped with this machinery; five contracts for such installations in the States were canceled in 1941 owing to paper shortage and priorities.

Salient statistics of the packaged-fuel industry from 1936 to 1941 are summarized in the following table; 1935 is the first year for which these data were collected by the Bureau of Mines.

Salient statistics of the packaged-fuel industry in the United States, 1936–41

[Data regarding fuel briquets are given separately at beginning of this chapter]

Year	Production (thousands of net tons)			Value of production (thousands of dollars)	Plants in operation	Average output per plant (thousands of net tons)	Average value per net ton, f. o. b. plant	
	Eastern and Pacific Coast States	Central States	Total				Eastern and Pacific Coast States	Central States
1936	6	60	66	505	48	1	$8.84	$7.49
1937	10	136	146	1,287	64	2	9.62	8.76
1938	9	152	161	1,405	76	2	9.92	8.66
1939	9	207	216	1,867	103	2	9.69	8.62
1940	8	277	285	2,392	106	3	10.12	8.36
1941	10	260	270	2,472	103	3	10.95	9.09

Production and value.—The 103 active plants, all but 7 of which are in the Central States, produced 269,844 net tons valued at $2,471,567 in 1941 (see fig. 2). Production for the first time decreased—5 percent less than in 1940—but the value increased 3 percent.

Output declined in all but 4 of the 13 States producing packaged fuel; the States showing increases were Maine, Illinois, Iowa, and Missouri. However, Michigan, Ohio, and Wisconsin (in order named) continue to be the largest producers.

The increase in value probably is accounted for by the higher costs of raw materials and labor.

[18] From study in preparation by V. F Parry, Technologic Branch, Bureau of Mines, Golden, Colo.

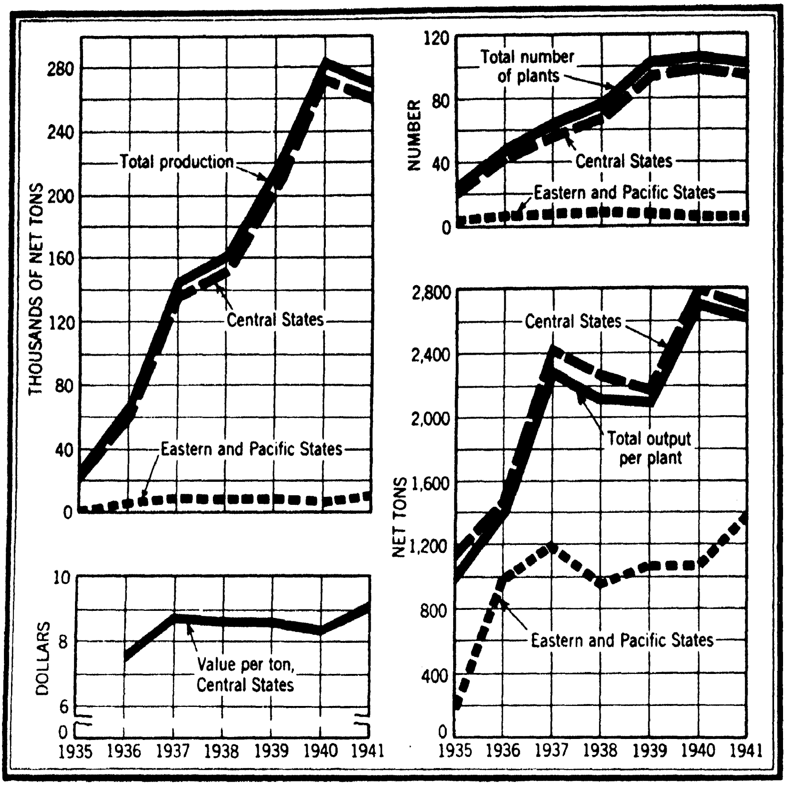

FIGURE 2.—Production of packaged fuel, number of plants in operation, output per plant, and average value per ton, f. o. b. plant (Central States), 1935-41.

Production of packaged fuel in the United States, 1940-41, by States

[The plants and production in this table are not included in the preceding fuel-briquet tables]

	1940			1941		
	Plants	Net tons	Value	Plants	Net tons	Value
Central States:						
Idaho	1	(1)	(1)			
Illinois	6	3, 813	$36, 531	6	8, 924	$95, 431
Indiana	7	15, 774	123, 255	6	13, 976	126, 560
Iowa	2	(1)	(1)	2	(1)	(1)
Michigan	36	112, 244	889, 720	38	93, 213	796, 226
Minnesota	7	28, 931	293, 623	6	28, 377	307, 134
Missouri	3	9, 150	65, 353	4	24, 356	199, 379
Nebraska	1	(1)	(1)	1	(1)	(1)
Ohio	23	61, 941	513, 499	20	46, 566	429, 744
Wisconsin	13	37, 968	329, 101	13	37, 747	345, 239
Undistributed [2]		7, 173	64, 748		7, 136	67, 250
Total Central States	99	276, 994	2, 315, 830	96	260, 295	2, 366, 963
Eastern and Pacific Coast States	[3] 7	7, 519	76, 092	[3] 7	9, 549	104, 604
Total United States	106	284, 513	2, 391, 922	103	269, 844	2, 471, 567

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[2] Includes States entered as "(1)" above.
[3] Maine 2, Pennsylvania 1, Virginia 3, and Washington 1.

The values, by States, in the following table represent the average per ton received by operators in 1940 and 1941 and show the increased average realization at plants in 1941; similar advances also obtained in the other six producing States but cannot be shown because there were less than three operators in each State. As many plants sell to both consumers and retailers, the values do not represent the price per ton to consumers but indicate the average per ton received by producers on the total product (exclusive of delivery charges). The value at the plant comprises cost of coal at mine, freight rate, direct manufacturing cost, indirect manufacturing cost, and profit.

Average value received per net ton of packaged fuel, 1940–41

State	1940	1941	State	1940	1941
Illinois	$9 58	$10.69	Missouri	$7.14	$8 19
Indiana	7 81	9 06	Ohio	8 29	9 23
Michigan	7 93	8.54	Wisconsin	8 67	9.15
Minnesota	10 15	10 82			

The peak producing season is generally from October through April. The sharp rise beginning in September 1940 continued through March 1941 but dropped sharply in April and May. Production for the 1941–42 heating season was behind the previous season's record from September through December 1941—due largely to the warmer-than-normal temperatures in the North Central States that produce most of the output.

Twenty-nine plants operated each month of the year, 58 from 7 to 11 months, and 16 from 2 to 6 months.

Monthly production of packaged fuel in the United States, 1940–41, in net tons

Month	1940	1941	Month	1940	1941
January	36,160	39,594	August	7,350	10,184
February	29,460	37,727	September	21,680	17,422
March	34,035	40,893	October	29,564	27,183
April	31,518	17,592	November	36,181	30,506
May	17,429	6,318	December	35,656	30,296
June	2,811	5,028			
July	2,669	7,101		284,513	269,844

Number of plants.—One hundred and three plants reported production of packaged fuel on a commercial scale in 1941 (3 less than in 1940); 96 of these were also active in 1940, but 6 additional plants—in Michigan, Minnesota, and Missouri—began operations on a small scale in 1941. Eight of the 103 plants went out of business after operating part of the year.

Fourteen plants went out of business in 1941—the same number as in 1940. Since 1935 many plants have established themselves firmly and built up a stable business; however, during the development period of the packaged-fuel business a relatively large number of plants began to operate and soon thereafter went out of business. Records show that from 1935 to 1941, inclusive, of the 133 plants starting operations 43 went out of business. Cost of raw materials, prices of competing fuels, and, more recently, shortages of paper and

other equipment are influencing factors in the decreased packaged-fuel production and number of plants in operation. There seems to be considerable competition within the industry itself in cities having numerous packaged-fuel operations—notably in Detroit, Mich., and Cleveland, Ohio, each with more than 10 such plants. [19]

Activity in number of packaged-fuel plants, 1936–41

Year	Active	New	Idle	Out of business	Year	Active	New	Idle	Out of business
1936	48	23	5	2	1939	103	29	11	9
1937	64	17	6	3	1940	106	16	15	14
1938	76	16	8	1	1941	103	[1] 7	[2] 8	[3] 14

[1] 4 in Michigan and 1 each in Indiana, Minnesota, and Missouri; all but 1 active in 1941.
[2] 4 in Ohio and 1 each in Idaho, Indiana, Michigan, and Missouri; 5 of these were also idle in 1940.
[3] 6 in Michigan, 2 each in Minnesota, Ohio, and Indiana, and 1 each in Missouri and Wisconsin; 11 of these were active in 1940.

Size of plants.—The average annual production per plant dropped slightly—from 2,700 tons in 1940 to 2,600 in 1941.

Reports submitted on individual capacity for 1941 indicate that the 103 active plants were equipped to produce about 698,000 tons (2.6 times the 1941 production) if operated at full capacity throughout the year. Few plants reported installation of additional equipment or replacements in 1941.

Classification of packaged-fuel plants in the United States, 1940–41, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1940	1941		1940	1941
Less than 500	[1] 23	[2] 25	Less than 5,000	62	68
500 and less than 1,000	19	19	5,000 and less than 10,000	25	17
1,000 and less than 3,000	40	39	10,000 and less than 15,000	6	6
3,000 and less than 5,000	10	5	15,000 and less than 25,000	7	6
5,000 and less than 10,000	9	9	25,000 and less than 40,000	5	5
10,000 and less than 25,000	4	5	40,000 and less than 60,000		
25,000 and over	1	1	60,000 and over	1	1
	106	103		106	103

[1] 4 of these began operations in the fall of 1940.
[2] 2 of these began operations in the fall of 1941.

Raw fuels.—The tonnage of raw fuels used in the manufacture of packaged fuel in 1941 totaled 266,818 net tons. Low-volatile bituminous slack continued to be the principal raw fuel used, representing 80 percent of the total; petroleum coke, Arkansas semianthracite, high-volatile bituminous, and coke breeze followed in the order named. Petroleum coke rose significantly from 5 percent of the total raw fuels used in 1939 to over 18 percent in 1941; this type of packaged fuel is now made in Illinois, Iowa, Minnesota, Missouri, Nebraska, Ohio, Washington, and Wisconsin. Coke breeze, combined with petroleum coke, was reported for the first time in 1941 by an operator in Missouri.

[19] Black Diamond, In the Realm of the Retail Merchant—Detroit Retailers Spend Enormous Sums for Price-cut Newspaper Ads: Vol. 106, No. 3, February 8, 1941, pp. 16, 46.

In 1941, low-volatile bituminous cubes were made at 90 plants, petroleum-coke cubes at 11, semianthracite cubes at 2, and high-volatile bituminous cubes at 1; cubes of mixtures of the various raw fuels were made at 5 plants. Six operators made more than one kind, and three operators made cubes in two sizes.

Of the total raw fuels used, about 215,000 tons (81 percent) were shipped-in slack from the mines and from the Lake docks; the remainder (about 52,000 tons or 19 percent) represents the yard screenings used. Of the 103 operations in 1941, 51 operators used shipped-in slack exclusively; 29 packaged their yard screenings only; and 23 used both shipped-in slack and yard screenings.

Raw fuels used in making packaged fuel in the United States, 1940–41

Raw fuel	Net tons		Percent of total	
	1940	1941	1940	1941
Bituminous (high-volatile) and semianthracite	4,898	4,784	1.7	1.8
Bituminous (low-volatile)	245,881	213,474	87.4	80.0
Petroleum coke	30,555	[1] 48,560	10.9	18.2
	281,334	266,818	100.0	100.0

[1] Includes small tonnage of coke breeze.

Binders.—Cornstarches of various types, averaging about 15 pounds per ton of packaged fuel produced, are the principal binders. Cement, asphalt, and sulfite cellulose—either alone or in combination with starch—were also employed. An approximate total of 1,800 tons of starch and 1,500 tons of asphaltic pitch and smaller amounts of other binders were used by operators of packaged-fuel plants. The following table classifies the packaged-fuel plants in 1941 according to type and percentage of binder used.

Classification of packaged-fuel plants in the United States in 1941, by type and percentage of binder used

Type of binder	Plants	Ratio of binder to raw fuel (by weight)	Plants
Starch	91	Less than 0.5 percent	
Starch and cement	3	0.5 and less than 1 percent	71
Starch and asphalt	1	1 and less than 2 percent	26
Cement	5	2 and less than 3 percent	4
Asphalt	2	3 and less than 5 percent	
Sulfite cellulose	1	5 percent and over	2
	103		103

PEAT

By Joseph A. Corgan

SUMMARY OUTLINE

Peat production in 1941 amounted to 86,503 short tons valued at $657,556, a substantial increase over the 1940 output of 70,097 tons valued at $516,865. The 1941 output, although the largest since the World War of 1914–18, did not equal the peak United States production of peat products in 1918—107,261 tons. The 1918 output was produced by 25 plants operating in 13 States, whereas the 1941 production came from 49 operators in 17 States; thus it would seem that should there be an increased demand (such as was experienced in 1918) for peat from domestic sources the peat industry today, being more widespread and comprising more producing plants, will be better equipped to fill it.

Imports of peat moss have been curtailed drastically on account of the war. During the first 9 months of 1941, 22,127 short tons of peat moss valued at $507,856 were imported into the United States; owing to censorship, imports for the last 3 months of the year cannot be published. In 1940 peat-moss imports totaled 21,689 tons valued at $454,632; and in 1939, before the war became world-wide, imports were 78,611 tons with a reported value of $1,204,883. Although a decrease in foreign supplies of peat moss will no doubt inconvenience regular consumers, an opportunity is presented to producers in the United States to develop their deposits and expand the market for the domestic product.

A directory listing the names and addresses of operators who reported their production in 1941 to the Bureau of Mines has been prepared and will be sent, upon request, to those who may be interested.

Reserves.—About one-half of the States contain some peat reserves, which constitute an important asset to the natural resources of the country. The total, calculated as air-dried peat, has been estimated at 13,827,000,000 short tons.[1]

PRODUCTION

The increase in domestic production from 70,097 short tons in 1940 to 86,503 tons in 1941 probably was due in part to the restriction of imports from foreign countries.

The 1941 output showed an increase of 23 percent in quantity and 27 percent in value over 1940. The average value a ton in 1941 was

[1] Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: Geol. Survey Bull. 728, 1922, p. 92.

$7.60 compared with $7.37 and $6.53 in 1940 and 1939, respectively. The production and value of peat for the years 1936 to 1941 are shown in the following table.

Peat produced in the United States, 1936–41

Year	Short tons	Value	Year	Short tons	Value
1936	46,126	$266,883	1939	55,483	$362,066
1937	51,223	305,156	1940	70,097	516,865
1938	45,933	286,127	1941	86,503	657,556

The trend of peat production and value is presented graphically in figure 1 for 1908 to 1926 and 1934 to 1941. The Federal Government made no canvass of the peat industry from 1927 to 1933, inclusive, and no data for these years are available.

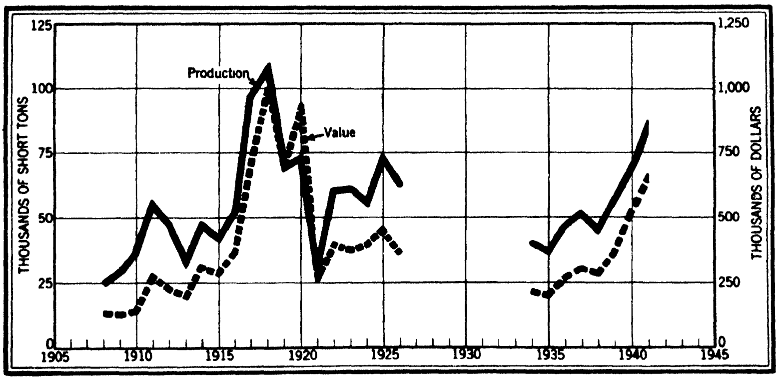

FIGURE 1.—Quantity and value of peat production, 1908–41; no data available for 1927–33

Forty-nine operators in 17 States reported to the Bureau of Mines in 1941, a decrease of 1 producer compared with 1940; however, in 1940 reports were received from only 15 States. Thus, the industry is more widespread and should be better equipped to handle an increased demand for peat.

In 1941 the producing States, in order of output, were: New York, Illinois, New Jersey, Michigan, Maine, Iowa, Pennsylvania, California, Connecticut, Colorado, Florida, Wisconsin, Ohio, Minnesota, Massachusetts, Washington, and New Hampshire.

Of the total production, peat humus represented 41 percent; reed or sedge peat, 40 percent; and moss peat and other, 19 percent. Peat humus was produced in 12 States; reed or sedge peat, in 9 States; and moss peat and other in 9 States.

Thirty-six plants reported production of shredded peat; 17. raw peat; and 8, cultivated peat.

USES

As for many years in the past, a large percentage of the sales of peat in the United States has been for soil improvement. The reports of sales indicate that 75 percent was sold for this purpose in 1941; 20

percent for use in mixed fertilizers; and 5 percent for other uses, including litter for barns and poultry yards. Peat is utilized to some extent also as a packing material for fruits, vegetables, shrubs, and fragile articles. No sales of peat for fuel purposes were reported. Peat is burned extensively in some European countries as a fuel, and reports indicate that because of the dislocation of fuel supplies throughout the war zone efforts are being made to extend its use, in order that the deficiency in customary fuels may be partly filled. In the United States, with its plentiful supplies of higher-grade fuels, peat has not been able to compete on a commercial scale, although in 1918, during the World War, 20,567 tons were used for fuel purposes.

It is of interest to note that during the World War of 1914–18, moss peat was collected for surgical dressings and 595,540 [2] moss-peat pads were prepared in this country and used in military hospitals both here and in Europe. Most of the moss peat was gathered from Maine, Oregon, and Washington bogs, and the pads were prepared under the direction of the American Red Cross. It has not been found necessary to do any work of this kind during the present war because of the plentiful supply of cotton and available facilities for making surgical dressings and pads from that material.

United States Government specifications.—There are great differences in the kinds of peat, both as to character and value for specific uses. In purchasing its peat requirements, the Federal Government has certain specifications that must be met. These specifications may be obtained from the Procurement Division, United States Treasury Department, Washington, D. C.

IMPORTS [3]

The decrease in peat-moss imports in 1940 and for the January-September period of 1941 may be attributed to a shortage of shipping facilities and general dislocation of commerce because of the war. For the first 9 months in 1941, imports totaled 22,127 short tons with a reported value of $507,856. Imports in 1940 amounted to 21,689 tons valued at $454,632, and in 1939 (the last year that might be considered normal), imports were 78,611 tons valued at $1,204,883.

Before 1940, Germany was for many years the principal exporter of peat to the United States. In 1939, imports from Germany were 28,127 tons valued at $389,597. In 1940 only 41 tons were imported from Germany, and during the first 9 months of 1941 only 15 tons were received from that country.

Peat moss imported for consumption in the United States, 1936–41

Year	Short tons	Value	Year	Short tons	Value
1936	75,066	$955,807	1939	78,611	$1,204,883
1937	86,871	1,219,127	1940	21,689	454,632
1938	69,509	1,092,942	1941 (Jan.-Sept.)	22,127	507,856

[2] Hotson, J. W., Sphagnum from Bog to Bandages: Washington Univ. Puget Sound Biol. Sta. Pub., vol. 2, No. 47, 1919, pp. 213, 243.
[3] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Sweden and the Netherlands exported substantial quantities of peat to the United States before 1940, but in the January–September period of 1941 no imports were received from these countries. Except for the 15 tons received from Germany, all imports in the January–September period of 1941 came from Canada and the United Kingdom. The average value of the imported product per ton increased from $20.96 in 1940 to $22.95 in the first 9 months of 1941. These values show a large increase over 1939 and 1938, when the averages were $15.33 and $15.72, respectively.

Peat moss imported for consumption in the United States, 1940–41, by countries

Country	All grades [1]		Poultry and stable grade				Fertilizer grade			
	1940 (Jan. 1–June 15)		1940 (June 16–Dec. 31)		1941 (Jan.–Sept.)		1940 (June 16–Dec. 31)		1941 (Jan.–Sept.)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada	4,294	$105,026	1,825	$46,857	8,594	$221,128	7,003	$153,661	12,674	$270,717
Denmark	389	8,556								
Germany	41	340			15	388				
Latvia	146	2,889								
Netherlands	3,136	44,394								
Sweden	2,679	64,749								
United Kingdom	787	8,758	120	2,241	34	578	1,269	17,161	810	15,045
	11,472	234,712	1,945	49,098	8,643	222,094	8,272	170,822	13,484	285,762

[1] Not separately classified.

WORLD PRODUCTION

Data on production of peat throughout the world are exceedingly incomplete, principally because of the war. The following table shows statistics for most countries in 1938 and 1939 and information available for 1940 and 1941.

World production of peat, 1938–41, by countries [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938	1939	1940	1941
Canada (fuel) .... metric tons	454	404	27	454
Denmark .... do	(2)	(2)	[3] 2,500,000	(2)
Estonia .... do	185,600	(2)	(2)	(2)
Latvia				
Litter .... cubic meters	90,369	80,000	(2)	(2)
Waste .... do	14,901	20,000	(2)	(2)
Insulation .... do	2,440	3,000	(2)	(2)
Lithuania .... metric tons	180,000	230,000	(2)	(2)
Netherlands .... do	800,000	822,400	842,000	(2)
Sweden:				
Fuel .... do	25,711	22,953	(2)	(2)
Litter, baled .... do	99,998	(2)	(2)	(2)
Litter and "mull," unbaled .... cubic meters	36,578	(2)	(2)	(2)
"Mull", baled .... metric tons	31,959	(2)	(2)	(2)
Switzerland .... do	10,000	15,000	12,000	(2)
U. S. S. R. .... do	26,460,700	(2)	(2)	(2)
United States .... do	41,669	50,333	63,591	78,474

[1] In addition to the countries listed, Argentina, Austria, Eire, Finland, France, Germany, Hungary, Italy, Norway, and Poland produce peat, but data of production are not available.
[2] Data not available.
[3] Estimated.

CRUDE PETROLEUM AND PETROLEUM PRODUCTS[1]

By A. G. White, G. R. Hopkins, H. A. Breakey, and A. T. Coumbe

SUMMARY OUTLINE

GENERAL REVIEW

A material expansion in normal business, combined with the rapidly growing production of war materials for domestic defense and export, raised the total demand for oil products above all former records in 1941.

Compared with 1940, there was a further substantial decline in this Nation's exports and an increase in imports from other American countries. As the net exports were reduced to less than 1 percent of total demand, the major factor in 1941 was the growth in domestic demand. The total domestic demand for all oils was about 11 percent higher than in 1940, giving an increase of 12 percent for motor fuel, 12 percent for residual fuel oils, 8 percent for distillate fuel oil, 20 percent for lubricating oils, and 26 percent for asphalt.

World production of crude petroleum in 1941 was less affected by the war than might have been expected; it is estimated at approximately 2,227 million barrels—an increase of 85 million barrels or approximately 4 percent. About 51 million of this increase was in the United States, whereas a gain of 38 million barrels is indicated for Venezuela and 20 million for Russia. The principal declines were 12 million barrels in Iraq, 8 million in the Netherlands Indies, and 4 million in Rumania.

Production in the United States was supplemented by a withdrawal of about 18 million barrels from stocks of domestic crude oil as compared with an increase of 23 million barrels in 1940. The demand for domestic crude oil in the United States rose from 1,330 million barrels in 1940 to 1,422 million in 1941—a gain of 92 million barrels or about 7 percent.

During 1941, crude runs to stills and crude production showed constant acceleration. Crude runs totaled 1,409 million barrels—a

[1] Data for 1941 are preliminary; detailed statistics with final revisions will be released later.

daily average of 3,861,000 barrels or a 9-percent gain over 1940. Crude production for the year amounted to 1,404 million barrels—a daily average of 3,847,000 barrels or a gain of about 3.8 percent over 1940. Stocks of all oils declined about 11 million barrels in 1941, representing a decrease of almost 19 million barrels in all crude stocks, a decline of over a million barrels in natural-gasoline stocks, and an increase of over 9 million barrels in stocks of refined oils.

Total demand for all oils in the United States, 1932–41

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1932	835.5	103.3	938.8	1937	1,169.7	172.8	1,342.5
1933	868.5	106.7	975.2	1938	1,137.1	193.7	1,330.8
1934	920.2	114.5	1,034.7	1939	1,231.1	188.9	1,420.0
1935	983.7	129.0	1,112.7	1940	1,326.6	130.5	1,457.1
1936	1,092.7	132.0	1,224.7	1941 [1]	([2])	([2])	1,578.3

[1] Subject to revision. [2] Not available.

As import and export data for the last quarter of 1941 cannot be published, no exact figures of demand, by products, are available. The total demand for all oils increased more than 8 percent compared with 1940. During the first 9 months of 1941, compared with the same period of 1940, total exports were 27 million barrels less, total imports gained about 7 million barrels, and domestic demand for all oils increased about 114 million barrels, or almost 12 percent.

In the first quarter of 1941, the demand for all oils gained only 2.6 percent over the same period in 1940. Exports reached the lowest level and were only 19.7 million barrels for the quarter. The demand for heating oils increased to only a slight degree in comparison with the demand during the abnormally cold weather in the first quarter of 1940. The production of crude petroleum averaged 3,603,000 barrels daily, and about 2.6 million barrels were added to crude stocks of domestic origin. Daily average runs to stills of 3,580,000 barrels were supplemented by a reduction of 7.1 million barrels in stocks of refined oils. The increase in gasoline stocks was less than normal, and the peak of 98.7 million barrels of finished and unfinished gasoline stocks on March 31 was about 5 million barrels less than on the same date in 1940.

In the second quarter of 1941, the demand for all oils increased 7.8 percent over that in the same period of 1940. Total exports for the quarter rose to 26.5 million barrels. Crude production increased to a daily average of 3,770,000 barrels and was supplemented by a reduction of 8.1 million barrels in crude stocks of domestic origin. Runs to stills averaged 3,808,000 barrels daily, with a total gain of about 1.4 million barrels in stocks of refined oils. The loan of tankers to Great Britain reduced movements from the Gulf and led to curtailment of gasoline deliveries to distributors in the East Coast area in an effort to build up stocks of fuel oils to meet the winter peak demand.

In the third quarter of 1941, the demand for all oils gained 13.9 percent compared with the same period of 1940. Total exports rose to 29.1 million barrels in spite of the discontinuance of shipments to Japan in early August. Crude production rose to a daily average of

3,903,000 barrels, and daily runs to stills averaged 3,992,000 barrels. Crude stocks of domestic origin declined 13.6 million barrels during the quarter, but stocks of refined oils rose 7.2 million barrels. The return of tankers loaned to Great Britain combined with restricted gasoline consumption in the East Coast district resulted in the rise of stocks of all oils in that district to 76.6 million barrels on September 30, a point still 5 million barrels below the stocks on the same date in 1940.

In the fourth quarter of 1941, the demand for all oils was approximately 9 percent above that for the same period in 1940. Exports continued to increase. Exceptionally mild weather reduced heating-oil demand below normal expectations, and stocks of all oils in the East Coast area reached a peak of 81.7 million barrels on November 30—a point 6.4 million barrels higher than on the same date in 1940. Crude production averaged 4,106,000 barrels daily for the quarter and runs to stills were 4,058,000 barrels daily; both figures represented new quarterly records. Crude stocks of domestic origin increased about 0.8 million barrels, and stocks of refined oils rose 8 million barrels. Stocks of finished and unfinished gasoline showed an abnormal increase of over 14 million barrels during the quarter and totaled 94.1 million barrels on December 31—almost 10 million barrels more than on December 31, 1940.

Salient statistics of crude petroleum, refined products, and natural gasoline in the United States, 1937–41

	1937	1938	1939	1940	1941 [1]
Crude petroleum:					
Domestic production ......thousands of barrels [2]	1,279,160	1,214,355	1,264,962	1,353,214	1,404,182
World production ......do	2,039,231	1,988,041	2,085,444	2,141,946	2,226,836
United States proportion of world production ......percent	63	61	61	63	63
Imports [3] ......thousands of barrels [2]	27,484	26,412	33,095	42,662	[4] 36,334
Exports [5] ......do	67,234	77,254	72,076	51,496	[4] 25,619
Stocks, end of period.					
Refinable crude ......do	305,833	274,958 [6] 274,165	239,978	264,079	246,884
California heavy crude ......do	14,505	16,467	13,330	11,906	10,179
Runs to stills ......do	1,183,440	1,165,015	1,237,840	1,294,162	1,409,192
Total value of domestic production at wells ......thousands of dollars	1,513,340	1,373,060	1,294,470	1,385,440	[7] 1,570,000
Average price per barrel at wells	$1.18	$1.13	$1.02	$1.02	[7] $1.12
Total producing oils wells in the United States, Dec. 31	363,030	369,640	380,390	389,010	([8])
Total oil wells completed in the United States during year	22,143	18,433	17,485	19,125	19,195
Refined products:					
Imports [5] ......thousands of barrels [2]	29,673	27,896	25,965	41,089	[4] 30,697
Exports [5] ......do	105,600	116,474	116,883	78,970	[4] 49,618
Stocks, end of period ......do	239,632	259,665 [6] 272,241	268,109	282,265	290,375
Output of motor fuel ......do	571,727	569,162	611,043	616,695	690,958
Yield of gasoline ......percent	43 9	44.3	45 0	43 1	44.2
Completed refineries, end of year	551	538	547	556	522
Daily crude-oil capacity of refineries ......thousands of barrels [2]	4,351	4,509	4,629	4,719	4,957
Average dealer's net price (excluding tax) of gasoline in 50 United States cities..cents per gallon [9]	10.53	10.04	9.58	9.08	9.49
Natural gasoline:					
Production ......thousands of barrels [2]	49,177	51,347	51,650	55,700	64,204
Stocks, end of period ......do	4,758	4,830	4,421	5,704	4,275

[1] Subject to revision.
[2] 42 gallons.
[3] As reported to the Bureau of Mines.
[4] Figures for imports and exports for 1941 cover January to September, inclusive.
[5] Department of Commerce; exports include shipments to noncontiguous Territories.
[6] For comparison with succeeding year.
[7] Estimated.
[8] Figures not available.
[9] American Petroleum Institute.

Supply and demand of all oils in the United States in 1941, by months

[Including wax, coke, asphalt, and still gas in thousands of barrels]

	1941 [1]													1940 (total)
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct	Nov.	Dec.	Total	
New supply:														
Domestic production:														
Crude petroleum	110,647	100,791	112,817	111,080	116,976	115,027	118,251	121,354	119,446	126,145	123,355	128,293	1,404,182	1,353,214
Natural gasoline	4,884	4,565	4,916	4,980	5,181	5,095	5,252	5,639	5,664	5,952	5,994	6,082	64,204	55,700
Benzol	313	280	317	277	288	274	271	277	266	296	287	323	3,469	3,167
Total production	115,844	105,636	118,050	116,337	122,445	120,396	123,774	127,270	125,376	132,393	129,636	134,698	1,471,855	1,412,081
Imports:														
Crude petroleum	2,793	3,371	3,821	3,831	3,866	4,332	5,331	4,327	4,662	(2)	(2)	(2)	(2)	42,662
Refined products	2,910	3,387	4,977	2,888	2,811	2,720	1,933	3,627	5,444					41,089
Total new supply, all oils	121,547	112,394	126,848	122,056	129,122	127,448	131,038	135,224	135,482	(2)	(2)	(2)	(2)	1,495,832
Change in stocks, all oils	−4,694	+240	−831	−2,076	−1,241	−2,795	−3,841	−3,390	+197	+3,962	+2,066	+1,469	−10,934	+38,746
Demand:														
Total demand	126,241	112,154	127,679	125,132	130,363	130,243	134,879	138,614	135,285	(2)	(2)	(2)	(2)	1,457,096
Exports:														
Crude petroleum	1,687	1,342	1,988	2,503	4,339	3,934	3,651	3,275	2,900					51,496
Refined products	5,531	4,075	5,063	5,060	5,438	5,216	4,703	8,284	6,248					78,970
Domestic demand:														
Motor fuel	45,344	42,001	48,760	55,154	59,307	58,360	63,093	62,944	58,995	(2)	(2)	(2)	(2)	589,490
Kerosine	7,769	6,484	6,821	5,549	4,504	3,918	4,270	4,449	5,624					68,776
Distillate fuel oil	21,010	17,783	19,847	12,264	11,233	10,853	10,586	9,667	11,670					160,851
Residual fuel oil	32,817	30,612	32,645	30,792	29,997	29,038	28,887	30,169	31,534					340,163
Lubricating oil	2,367	1,798	2,263	2,712	2,732	3,171	3,074	2,562	2,638					24,690
Miscellaneous	9,716	8,059	10,292	11,098	12,813	15,753	16,615	17,264	15,676					142,650
Total domestic demand	119,023	106,737	120,628	117,569	120,586	121,093	126,525	127,055	126,137	(2)	(2)	(2)	(2)	1,326,620
Stocks:														
Refinable crude petroleum in U. S.	263,251	264,432	266,380	266,012	262,111	259,075	255,378	249,620	246,111	243,735	243,679	246,884	246,884	264,709 [3] 264,079
Heavy crude petroleum in Calif.	11,839	11,886	11,776	11,802	11,241	10,711	10,556	10,942	10,321	9,869	10,203	10,179	10,179	11,906
Natural gasoline	5,490	5,311	5,331	5,504	5,856	6,235	6,317	6,111	5,373	4,870	4,557	4,275	4,275	5,704
Refined products	277,373	276,564	273,875	271,968	274,837	275,229	275,158	277,346	282,411	289,704	291,805	290,375	290,375	282,265 [3] 280,958
Total, all oils	557,953	558,193	557,362	555,286	554,045	551,250	547,409	544,019	544,216	548,178	550,244	551,713	551,713	564,584 [3] 562,647

[1] Subject to revision.

[2] Publication suspended.

[3] For comparison with 1941.

Just before the United States entered the war, serious consideration was being given to the maintenance of crude production and refinery operations at even higher levels in expectation of a possible 5- to 10-percent increase in total demand during 1942. The whole trend of expected demand was reversed, however, by the subsequent loss of the principal sources of rubber supply and the curtailment of oil consumption in the major East Coast market owing to necessary readjustments in tanker transportation.

Fortunately for the East Coast area, the threatened shortage of supply due to diversion of tankers in the summer of 1941 had paved the way for initiating the steps necessary to increase overland tank-car movements, construct new pipe lines, speed tanker movements, pool supplies, and distribute extra costs. These measures and unusually mild fall weather combined to maintain stocks in the East Coast district at a high point to the end of 1941 and made it possible to bridge peak winter demand without serious inconvenience.

By February 1942 a drastic cut in expected domestic gasoline demand became apparent in consequence of the decreased use of automobiles to save wear on tires. By March, steps were taken to conserve the dwindling stocks of oil in the East Coast area by curtailing deliveries of gasoline to distributors one-third, and by May gasoline ration cards were in use. With prospects of a heavy cut in civilian gasoline consumption in 1942, runs to stills and the demand for crude oil began to drop far below expectations. This decline in runs was accentuated by the large stocks of gasoline on hand, by the problems of readjustment in refinery yields to produce more fuel oils and less gasoline, by changes in transportation routes at higher costs, and by the problem of price adjustments involved in the new movements and in the relatively greater output of heavy fuel oils required.

The long-term trends of supply and demand are shown in figure 1.

The experience of the United States duplicates that of other countries, in that the direct and indirect effects of war tend to curtail civilian consumption of petroleum and thus offset increased military requirements. In nearly every instance the forecasts of large total increases in wartime consumption have proved erroneous. As regards this nation, the total oil supply and demand are so large that direct military and naval requirements are not likely to comprise more than a fraction of normal demand, and the effect on civilian consumption would naturally be less drastic.

Naval use of fuel oil generally increases three to four times over peace-time requirements in war time. In the World War of 1914–18 the supply of naval fuel oil was a major problem, accentuated by almost complete conversion of navies from a coal-burning basis in 1914 to an oil-burning basis in 1918. The tremendous expansion in air warfare is characteristic of present war operations and doubtless will greatly increase the relative amount of gasoline required, as evidenced by the program initiated in 1941 to increase 100-octane aviation-gasoline capacity threefold.

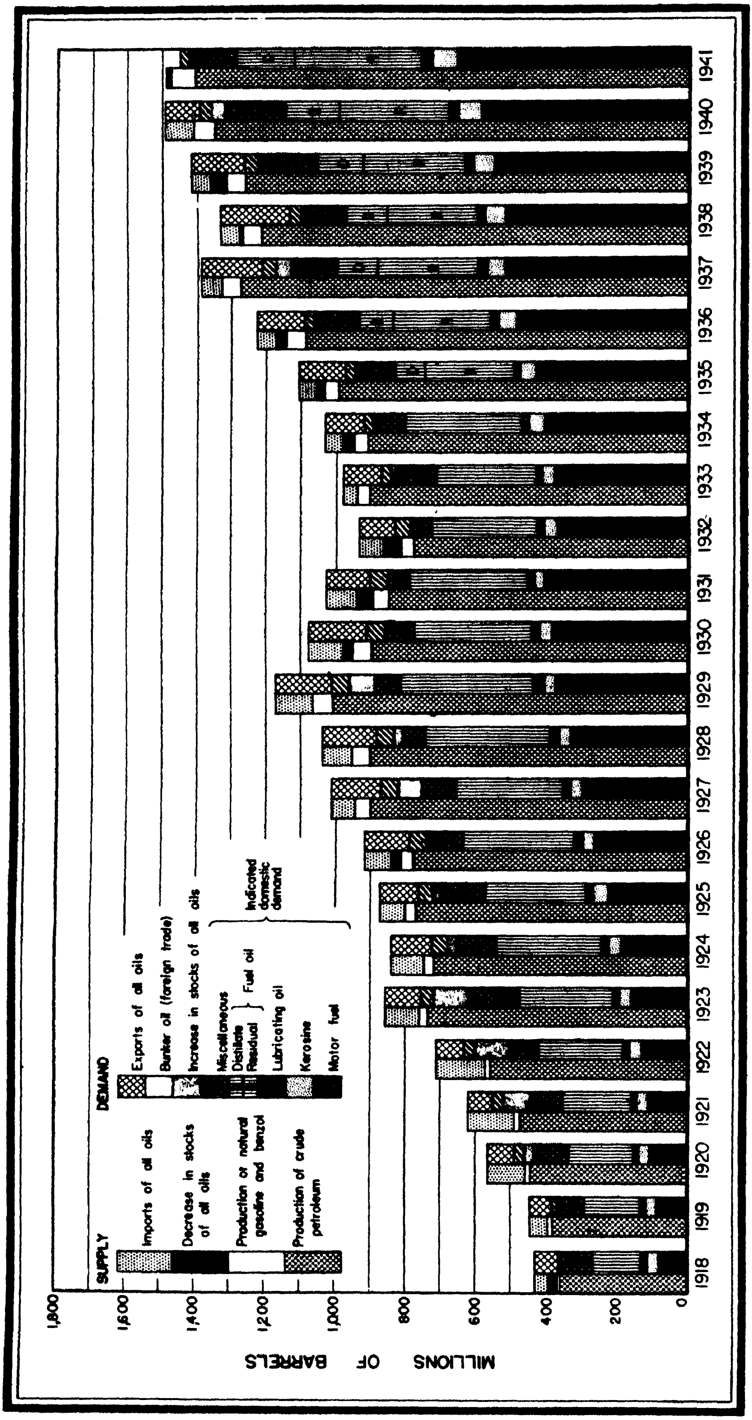

FIGURE 1.—Supply and demand of all oils in the United States, 1918–41.

RESERVES

Reserves of crude oil on January 1, 1942, were estimated by the American Petroleum Institute Committee on Petroleum Reserves at 19,589,296,000 barrels. These reserves include only crude oil and distillate, in known and proved fields, that are recoverable by present production methods. New discoveries in 1941 totaled 1,968,963,000 barrels, or 564,781,000 barrels more than was produced. Even though reserves are at the highest point they have ever reached, it is notable that there have been no large new discoveries in recent years. Of the additions to reserves in 1941, 1,538,989,000 barrels represented further development of fields discovered before 1941, leaving only 429,974,000 barrels as actual new field discoveries.

Estimates of proved oil reserves in the United States on January 1, 1935, and 1937–42, by States [1]

[Millions of barrels]

State	1935 [2]	1937 [2]	1938 [2]	1939 [2]	1940 [2]	1941 [2]	1942 [3]
Eastern States:							
Illinois	37	28	59	432	382	315	334
Indiana	5	3	7	6	14	14	23
Kentucky	50	39	38	49	44	41	36
Michigan	64	63	46	74	51	35	56
New York	75	66	45	40	35	65	60
Ohio	40	32	30	33	32	30	37
Pennsylvania	340	307	218	200	183	188	171
West Virginia	40	32	28	50	46	53	50
	651	570	471	884	787	741	767
Central and Southern States:							
Arkansas	103	87	171	332	320	306	295
Kansas	390	590	607	763	726	692	690
Louisiana	513	657	1,049	1,180	1,173	1,216	1,330
Mississippi					7	40	80
New Mexico	451	581	739	703	687	692	675
Oklahoma	1,235	1,384	1,311	1,206	1,063	1,002	1,036
Texas	6,643	8,343	9,692	10,180	9,768	10,624	10,976
	9,335	11,642	13,569	14,364	13,744	14,572	15,082
Mountain States:							
Colorado	16	19	19	22	20	23	23
Montana	102	115	109	99	94	89	86
Wyoming	267	260	280	327	306	305	304
	385	394	408	448	420	417	413
Pacific Coast States: California	3,261	3,251	3,303	3,710	3,532	3,291	3,323
Other States						4	4
Total United States	13,632	15,857	17,751	19,406	18,483	19,025	19,589

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute.
[2] Final revised estimates of the amount of crude oil that may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations.
[3] Subject to revision.

LEGISLATION AND ADMINISTRATION

Little legislation affecting the oil industry was promulgated in 1941; but administrative acts, either by the President of the United States or by administrators or boards appointed by him, had a material influence on the petroleum industry. Congressional action that affected the industry included passage of the Lend-Lease Act; passage of the Cole Pipe Line Act, giving pipe lines the right of eminent domain when needed for national defense; extension of the Interstate Oil Compact for 2 years; investigation of the East coast oil shortage; and passage of the Bland Act, raising load limits on tankers.

The administrative acts affecting the industry were the appointment of a Petroleum Coordinator by the President; requests and orders by the Office of Price Administration and Civilian Supply affecting prices; priority rulings by the Office of Production Management and Priorities and Allocation Board (both later merged into the War Production Board), not only for the purpose of allocating steel and other deficient commodities, but also for enforcing rulings by other boards; limitation of earnings of pipe-line companies to 8 percent of their valuation, by order of the Interstate Commerce Commission; Presidential prohibition of exports of filled and empty oil drums, except under license; loan of tankers to Britain and U. S. S. R.; prohibition of exports of petroleum products to Japan; assumption of coordination of the aviation-gasoline industry by the Office of Petroleum Coordinator; signing by the State Department of an agreement with Mexico providing a plan for settlement of the controversy over expropriation of United States-owned oil properties in Mexico; coordination of oil production and allocation of production rates for each State by the Office of Petroleum Coordinator; and prohibition by the Office of Petroleum Coordinator of the drilling of more than 1 well to 40 acres, to be enforced by withholding priorities for drilling equipment from violators.

The action that affected the oil industry most was the establishment of the Office of Petroleum Coordinator by order of the President on May 28, 1941, with Harold L. Ickes, Secretary of the Interior, as Coordinator. The Coordinator is empowered to obtain information regarding the needs and availability of petroleum and petroleum products and to recommend action that will insure maintenance of a supply thereof. The country is divided into five districts, and each district has four industry advisory committees dealing with production, refining, transportation, and marketing. These committees are appointed by the Coordinator from nominees selected by the industry and have contact with the Coordinator through a general committee composed of the chairmen of each committee, as well as the general chairman of each district.

Toward the end of the year, the Coordinator organized the Petroleum Industry Council for National Defense, later called the Petroleum Industry War Council. This council comprises 66 members selected from the petroleum industry, and the 25 men on the general committee described above are ex-officio members. The functions of the Council are to mobilize most effectively the resources and abilities of the petroleum industry; to advise the Petroleum Coordinator with respect to the petroleum industry; and to carry into effect measures recommended by the Coordinator as essential to national defense.

The Petroleum Coordinator has no power to enforce his decisions; they must be executed through voluntary cooperation of the industry or through other agencies with enforcement power, such as the War Production Board, acting on the recommendations of the Coordinator. The petroleum industry, through its Petroleum Industry War Council and its general and district committees, enjoys unusual facilities for contact with the Government.

PRORATION

Any doubt of a State's right to prorate oil production was removed when the Supreme Court early in the year upheld the Texas system of proration.

The Interstate Oil Compact Commission gained strength during the year when, in addition to extension of the Compact Commission Act 2 years by Congress, four more States joined—Arkansas, Louisiana, New York, and Pennsylvania. These, added to the older member States—Colorado, Illinois, Kansas, Michigan, New Mexico, Oklahoma, and Texas—make a total of 11 States now in the Commission.

Late in the year the Office of Petroleum Coordinator assumed the function of designating the quantity of crude oil to be produced and allocating the rates of production for each State. One of the most important features in this connection was the new production plan for California put into effect on January 1, 1942. This is the first regulatory measure for California, as heretofore proration in that State has taken the form of voluntary curtailment. Two acts to regulate oil and gas production, passed by the legislature, were defeated by referendum.

State allowables and Bureau of Mines estimates of market demand [1] compared with actual production [2] in the United States in 1941

[Daily averages, in thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Texas:												
State allowable [2]	1,316	1,332	1,364	1,388	1,431	1,434	1,360	1,426	1,418	1,502	1,548	1,577
Bureau of Mines estimate	1,298	1,313	1,327	1,355	1,382	1,372	1,324	1,361	1,379	1,420	1,455	1,480
Actual production	1,280	1,298	1,329	1,350	1,400	1,404	1,344	1,393	1,387	1,459	1,506	1,532
California:												
State allowable [3]	571	572	569	570	572	576	600	610	608	613	613	612
Bureau of Mines estimate	595	596	596	596	598	615	625	641	635	613	627	636
Actual production	609	613	610	614	623	639	639	642	647	651	651	632
Oklahoma:												
State allowable [4]	390	400	400	400	410	415	415	415	428	428	428	428
Bureau of Mines estimate	439	443	437	429	440	460	499	492	490	482	469	460
Actual production	417	423	421	418	416	422	434	429	437	419	425	428
Louisiana:												
State allowable [5]	293	295	306	301	320	320	310	325	329	339	347	355
Bureau of mines estimate	287	289	291	300	320	320	304	325	324	332	333	340
Actual production	289	296	304	306	315	323	315	317	320	332	344	347
Kansas:												
State allowable [6]	194	196	198	211	218	233	238	243	250	257	258	264
Bureau of Mines estimate	191	193	194	201	214	220	225	241	240	253	254	261
Actual production	197	199	202	208	210	230	241	244	246	252	249	257
New Mexico:												
State allowable [7]	104	106	110	110	114	113	109	113	113	115	117	117
Bureau of Mines estimate	100	101	104	109	114	113	109	113	113	115	115	116
Actual production	101	103	105	107	109	109	107	108	110	111	113	112
Arkansas:												
State allowable [8]	71	71	71	72	72	72	74	74	74	73	73	73
Bureau of Mines estimate	66	66	70	76	84	83	77	81	79	78	77	77
Actual production	70	70	71	72	72	72	73	75	74	72	72	74
Other States:												
Bureau of Mines estimate	615	628	637	643	648	647	684	686	700	720	740	769
Actual production	606	598	597	628	628	635	662	707	761	773	752	757
United States:												
Bureau of Mines estimate	3,591	3,629	3,656	3,709	3,800	3,830	3,847	3,940	3,960	4,013	4,070	4,139
Actual production	3,569	3,600	3,639	3,703	3,773	3,834	3,815	3,915	3,982	4,069	4,112	4,139

[1] State figures are estimates of demand, hence in comparing demand data with actual production due regard should be given to changes in stocks by States of origin. (Changes in stocks and demand are given elsewhere in this chapter.)
[2] Railroad Commission of Texas.
[3] Conservation Committee of California Oil Producers.
[4] Corporation Commission of Oklahoma.
[5] Department of Conservation, Louisiana.
[6] State Corporation Commission of Kansas.
[7] Oil Conservation Commission of New Mexico.
[8] Oil and Gas Commission.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The total demand for crude petroleum was approximately 1,474 million barrels in 1941—a gain of 101 million barrels or over 7 percent above that in the previous year. The domestic production of 1,404 million barrels was supplemented by a decline of almost 19 million barrels in all crude stocks compared with an increase of over 23 million in crude stocks in 1940. Imports of crude increased and exports declined, but total figures are not available for publication. Total runs to stills rose from 1,294 million barrels in 1940 to 1,409 million in 1941—a gain of 115 million barrels (8.9 percent).

Supply of and demand for crude petroleum in the United States, 1937–41

[Thousands of barrels]

	1937	1938	1939	1940	1941 [1]
Production	1,279,160	1,214,355	1,264,962	1,353,214	1,404,182
Imports [2]	27,484	26,412	33,095	42,662	[3] 36,334
Changes in stocks [4]	+18,247	−28,913	−37,324	+23,307	−18,922
Total demand	1,288,397	1,269,680	1,335,381	1,372,569	[3] 1,459,438
Runs to stills:					
Domestic	1,157,444	1,138,828	1,204,350	1,252,364	1,358,246
Foreign	25,996	26,187	33,490	41,798	50,946
Exports	67,234	77,254	72,076	51,496	[3] 25,619
Transfers to fuel-oil stocks	20,909	14,042	12,409	10,275	15,482
Other fuel and losses	16,814	13,369	13,056	16,636	9,145
Total demand	1,288,397	1,269,680	1,335,381	1,372,569	[3] 1,459,438

[1] Subject to revision.
[2] As reported to Bureau of Mines.
[3] Figures for imports and exports for 1941 cover January to September, inclusive.
[4] Exclusive of heavy crude in California.

PRODUCTION

Despite declines in exports of petroleum and its products in 1941, an increase of 51 million barrels in production of crude oil was required to supply the demand, even with a substantial reduction in stocks. Daily average production rose from 3,569,000 barrels in January (as shown in fig. 2), crossed the 4-million mark in October, and reached an average of 4,139,000 in December. Total production was 1,404,182,000 barrels compared with 1,353,214,000 in 1940.

The gain of 17,122,000 barrels in Kansas was the greatest of any State. Production in Texas increased 14,375,000 barrels and that in Louisiana 12,324,000. Illinois and Michigan declined 13,509,000 and 3,392,000 barrels, respectively, although the trend was upward in both States at the end of the year. The relative rank of the three highest producing States—Texas, California, and Oklahoma—declined further, so that in 1941 they supplied only 63.6 percent of the oil produced compared with 64.5 percent in 1940 (see fig. 3).

East Texas maintained its lead as the greatest producing field. The precipitous drop in output from the Salem (Ill.) field from 71 million barrels in 1940 to 30 million in 1941 reduced its rank from second to fourth. It was succeeded by the declining Oklahoma City field, whereas the Wilmington (Calif.) field, with a slight gain in production, ranked third.

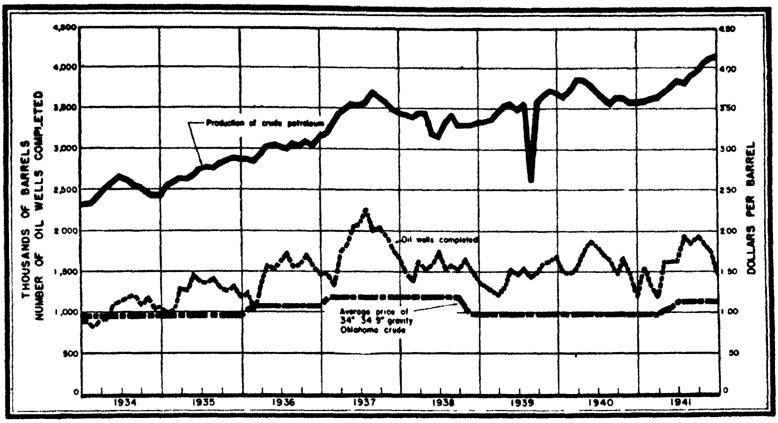

FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum in the United States, 1934–41, by months.

Petroleum produced in the United States, 1937–41, and total, 1859–1941, by States[1]

[Thousands of barrels]

	1937	1938	1939	1940	1941 [2]	1859–1941 (total)
Production:						
Arkansas	11, 764	18, 180	21, 238	25, 775	26, 327	532, 744
California	238, 521	249, 749	224, 354	223, 881	230, 263	5, 800, 341
Colorado	1, 605	1, 412	1, 404	1, 626	1, 875	41, 771
Illinois	7, 499	24, 075	94, 912	147, 647	134, 138	833, 810
Indiana	844	995	1, 711	4, 978	6, 634	137, 744
Kansas	70, 761	60, 064	60, 703	66, 139	83, 261	[3] 1, 204, 194
Kentucky	5, 484	5, 821	5, 621	5, 188	4, 762	[4] 171, 923
Louisiana	90, 924	95, 208	93, 646	103, 584	115, 908	1, 175, 897
Michigan	16, 628	18, 745	23, 462	19, 753	16, 361	[5] 161, 467
Mississippi			107	4, 400	15, 314	19, 821
Montana	5, 805	4, 946	5, 960	6, 728	7, 526	91, 018
Nebraska			2	276	1, 636	1, 912
New Mexico	38, 854	35, 759	37, 637	39, 129	39, 369	[6] 314, 128
New York	5, 478	5, 045	5, 098	4, 999	5, 185	[7] 123, 962
Ohio	3, 559	3, 298	3, 156	3, 159	3, 340	591, 717
Oklahoma	228, 839	174, 994	159, 913	156, 164	154, 759	[3] 4, 960, 882
Pennsylvania	19, 189	17, 426	17, 382	17, 353	16, 750	[7] 1, 013, 818
Texas	510, 318	475, 850	483, 528	493, 209	507, 584	7, 087, 391
West Virginia	3, 845	3, 684	3, 580	3, 444	3, 433	414, 203
Wyoming	19, 166	19, 022	21, 454	25, 711	29, 694	530, 672
Other States [8]	77	82	94	71	63	81, 185
Total United States	1, 279, 160	1, 214, 355	1, 264, 962	1, 353, 214	1, 404, 182	25, 210, 600
Value at wells:						
Total (thousands of dollars)	1, 513, 340	1, 373, 060	1, 294, 470	1, 385, 440	1, 570, 000	29, 713, 379
Average per barrel	$1. 18	$1. 13	$1 02	$1. 02	$1. 12	$1. 18

[1] For detailed figures by States, 1859–1935, see Minerals Yearbook, 1937, p. 1008.
[2] Subject to revision.
[3] Oklahoma included with Kansas in 1905 and 1906.
[4] Includes Tennessee, 1883–1907.
[5] Figures represent 1925–41 production only, earlier years included under "Other States."
[6] Figures represent 1924–41 production only, earlier years included under "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Includes Alaska, 1912–33; Arkansas, 1920; Michigan, 1900–1919; Missouri, 1889–1911, 1913–16, 1919–23, 1932–41; New Mexico, 1913, 1919–23; Tennessee, 1916–41: Utah, 1907–11, 1920, 1924–41.

Production of crude petroleum in the United States in 1941, by districts, States, and months

[Thousands of barrels]

District and State	1941[1] January	February	March	April	May	June	July	August	September	October	November	December	Total	1940 (total)
DISTRICT														
Pennsylvania Grade	2,225	1,946	2,129	2,233	2,247	2,164	2,293	2,213	2,308	2,418	2,191	2,441	26,808	26,972
Other Appalachian	554	505	540	541	536	512	552	508	516	527	471	532	6,294	6,790
Lima-Northeastern Indiana-Michigan	1,289	1,106	1,217	1,178	1,181	1,212	1,265	1,342	1,576	1,877	1,734	1,788	16,765	20,182
Illinois-Southwestern Indiana	10,908	9,641	10,946	10,848	11,042	10,933	11,419	12,642	13,222	13,636	12,603	12,908	140,748	152,601
Mid-Continent:														
North Louisiana, Arkansas, and Mississippi	4,814	4,528	4,901	5,031	5,263	5,139	5,969	6,016	5,916	6,315	6,526	6,577	66,995	54,581
West Texas and Southeastern New Mexico	9,730	9,174	10,327	10,453	11,238	10,971	11,044	11,341	11,072	11,911	12,091	12,725	132,077	123,224
East Texas	10,998	9,993	11,505	10,915	11,406	10,924	10,476	11,002	10,499	11,508	11,420	11,940	132,586	141,023
Oklahoma, Kansas, North Texas, etc	30,893	28,122	31,364	30,548	31,951	31,780	33,416	33,562	32,933	33,991	33,217	34,878	386,655	368,149
Gulf Coast	17,139	15,761	17,926	17,723	19,327	18,966	18,600	19,400	18,647	20,341	20,383	21,480	225,693	201,344
Rocky Mountain	3,216	2,858	3,059	3,188	3,467	3,258	3,412	3,416	3,354	3,434	3,202	3,434	39,298	34,467
California	18,881	17,157	18,903	18,422	19,318	19,168	19,805	19,912	19,403	20,187	19,517	19,590	230,263	223,881
Total United States	110,647	100,791	112,817	111,080	116,976	115,027	118,251	121,354	119,446	126,145	123,355	128,293	1,404,182	1,353,214
STATE														
Arkansas	2,158	1,950	2,191	2,147	2,237	2,163	2,254	2,315	2,226	2,218	2,164	2,304	26,327	25,775
California[2]	18,881	17,157	18,903	18,422	19,318	19,168	19,805	19,912	19,403	20,187	19,517	19,590	230,263	223,881
Colorado	111	100	111	152	154	153	160	184	183	187	191	189	1,875	1,626
Illinois	10,293	9,069	10,392	10,296	10,499	10,405	10,854	12,086	12,692	13,104	12,116	12,332	134,138	147,647
Indiana	617	574	556	554	545	530	567	558	532	534	489	578	6,634	4,978
Kansas	6,109	5,575	6,266	6,236	6,518	6,908	7,484	7,560	7,393	7,800	7,455	7,957	83,261	66,139
Kentucky	424	387	414	407	403	385	418	386	391	397	356	394	4,762	5,188
Louisiana	8,970	8,296	9,421	9,192	9,750	9,696	9,771	9,838	9,595	10,283	10,326	10,770	115,908	103,584
Michigan	1,252	1,070	1,189	1,143	1,141	1,169	1,234	1,307	1,545	1,845	1,707	1,759	16,361	19,753
Mississippi	541	603	570	767	901	858	1,425	1,598	1,694	1,932	2,240	2,185	15,314	4,400
Montana	597	561	598	591	611	617	648	646	642	684	648	683	7,526	6,728
New Mexico	3,134	2,870	3,263	3,219	3,369	3,272	3,310	3,342	3,285	3,442	3,385	3,478	39,369	39,129
New York	424	372	410	436	435	422	456	438	445	465	414	468	5,185	4,999
Ohio	263	245	258	281	285	284	283	270	287	300	276	308	3,340	3,159
Oklahoma	12,924	11,850	13,040	12,527	12,883	12,651	13,457	13,309	13,102	13,001	12,758	13,257	154,759	156,164
Pennsylvania	1,416	1,231	1,336	1,382	1,407	1,345	1,419	1,376	1,440	1,501	1,370	1,527	16,750	17,353
Texas	39,674	36,350	41,185	40,491	43,410	42,110	41,656	43,183	41,616	45,234	45,175	47,500	507,584	493,209
West Virginia	286	249	276	300	290	280	297	283	289	311	270	302	3,433	3,444
Wyoming	2,487	2,176	2,340	2,429	2,684	2,472	2,587	2,565	2,515	2,543	2,348	2,548	29,694	25,711
Other States[3]	86	106	98	108	136	139	166	198	171	177	150	164	[3] 1,699	347
Total United States: 1941	110,647	100,791	112,817	111,080	116,976	115,027	118,251	121,354	119,446	126,145	123,355	128,293	1,404,182	
1940	113,056	108,827	120,165	116,170	118,471	111,605	113,340	110,699	109,405	113,567	107,137	110,772		1,353,214
Daily average, 1941	3,569	3,600	3,639	3,703	3,773	3,834	3,815	3,915	3,982	4,069	4,112	4,139	3,847	3,697

[1] Subject to revision.
[2] American Petroleum Institute.
[3] Missouri (47), Nebraska (1,636), Tennessee (12), and Utah (4).

Pennsylvania Grade crude oil produced, 1932–41, by States

[Thousands of barrels]

State	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941 [1]
New York	3,508	3,181	3,804	4,236	4,663	5,478	5,045	5,098	4,999	5,185
Pennsylvania	12,396	12,607	14,462	15,794	17,053	19,173	17,407	17,363	17,334	16,731
West Virginia	3,875	3,815	4,095	3,901	3,846	3,844	3,684	3,580	3,444	3,433
Central and eastern Ohio	1,741	1,594	1,597	1,547	1,510	1,367	1,180	1,179	1,195	1,459
	21,520	21,197	23,958	25,478	27,072	29,862	27,316	27,220	26,972	26,808

[1] Subject to revision.

Percentage of total crude petroleum produced in the United States, 1932–41, by principal States

State	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941 [1]
Texas	39.8	44.5	42.0	39.4	38.9	39.9	39.2	38.2	36.4	36.2
California	22.7	19.0	19.2	20.9	19.5	18.6	20.6	17.7	16.6	16.4
Oklahoma	19.5	20.1	19.9	18.6	18.8	17.9	14.4	12.7	11.5	11.0
Total, 3 States	82.0	83.6	81.1	78.9	77.2	76.4	74.2	68.6	64.5	63.6
Louisiana	2.8	2.8	3.6	5.0	7.3	7.1	7.8	7.4	7.7	8.2
Kansas	4.4	4.6	5.1	5.5	5.3	5.5	5.0	4.8	4.9	5.9
New Mexico	1.6	1.6	1.9	2.1	2.5	3.1	2.9	3.0	2.9	2.8
Illinois	.6	.5	.5	.4	.4	.6	2.0	7.5	10.9	9.5
Michigan	.9	.9	1.2	1.5	1.1	1.3	1.5	1.8	1.5	1.2
Arkansas	1.5	1.3	1.1	1.1	.9	.9	1.5	1.7	1.9	1.9
Pennsylvania	1.6	1.4	1.6	1.6	1.6	1.5	1.4	1.4	1.3	1.2
All other	4.6	3.3	3.9	3.9	3.7	3.6	3.7	3.8	4.4	5.7
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.

Production of crude petroleum in leading fields and districts in the United States, 1940–41,[1] and total production since discovery

[Thousands of barrels]

Field	State	1940	1941	Total since discovery
East Texas [2]	Texas	141,000	[3] 132,600	1,704,000
Midway-Sunset	California	18,400	17,500	912,500
Seminole	Oklahoma	27,000	23,700	870,000
Long Beach	California	16,000	14,700	669,000
Oklahoma City [2]	Oklahoma	[4] 38,100	[3] 33,200	560,000
Santa Fe Springs	California	9,400	8,600	476,000
Bradford-Allegany	Pennsylvania-New York	17,700	17,200	456,000
Smackover	Arkansas	[4] 5,600	5,400	421,000
Coalinga	California	9,900	14,200	385,000
Yates district	Texas	7,600	6,700	351,000
Cushing-Shamrock	Oklahoma	3,400	3,200	345,000
Augusta-Eldorado district	Kansas	5,000	5,200	304,000
Huntington Beach	California	9,600	10,700	302,000
Salt Creek [2]	Wyoming	5,200	[3] 5,200	299,000
Wilmington	California	30,200	30,700	294,000
Kettleman Hills	do	16,700	14,000	253,000
Gray County	Texas	12,000	12,500	183,000
Caddo [2]	Louisiana	2,900	[3] 3,100	158,000
Salem	Illinois	70,700	29,500	153,000
Conroe	Texas	9,900	11,700	139,000
Rodessa	Arkansas-Louisiana-Texas	14,200	10,500	128,000
Hobbs	New Mexico	3,800	3,700	105,000
Fitts	Oklahoma	6,200	4,200	94,000
Louden	Illinois	26,600	22,900	70,000
Eunice	New Mexico	6,600	6,700	55,000
Monument	do	6,900	7,000	46,000
Lance Creek [2]	Wyoming	9,100	[3] 8,800	38,000
Wasson	Texas	11,100	13,200	33,000
Tinsley [2]	Mississippi	4,400	[3] 15,300	20,000

[1] Oil and Gas Journal, except as noted
[2] Bureau of Mines.
[3] Subject to revision
[4] Revised.

Arkansas.—A small gain (principally attributable to the younger fields, as the recoveries from the older ones were generally less than in the previous year)—552,000 barrels—raised the 1941 production to 26,327,000 barrels. The chief exception was the Urbana field, where more than doubling the number of wells in the past 2 years has increased the production from 381,000 barrels in 1939 to 837,000 in 1941. Production in the Atlanta field rose 292,000 barrels to 1,013,000, and the McKamie field—the largest gas reserve in the State—yielded 891,000 barrels of distillate.

Drilling operations continued to decline, as only 95 oil wells were completed in 1941 compared with 114 in 1940. The new Mount Holly field was the only oil field discovered during the year.

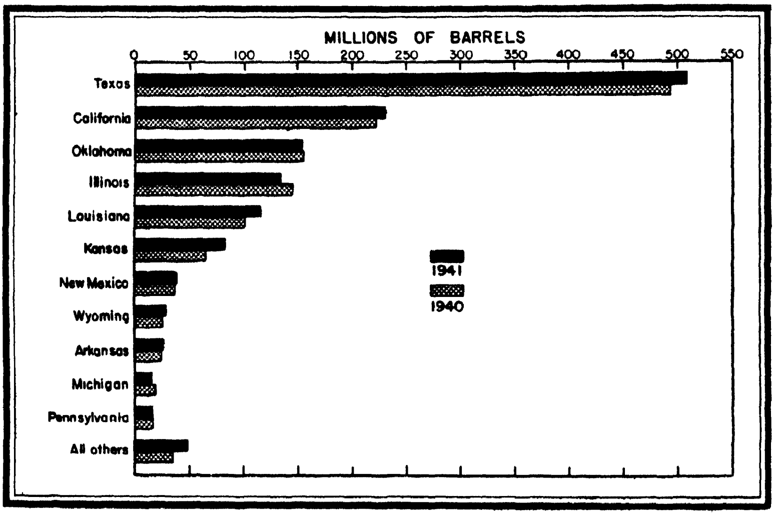

FIGURE 3.—Production of crude petroleum in the United States, 1940–41, by States.

Production of crude petroleum in Arkansas, 1937–41, by fields

[Thousands of barrels]

Year	Atlanta	Buckner	Champagnolle	El Dorado	Irma	Magnolia	McKamie	Rodessa	Schuler	Smackover	Urbana	Other fields	Total
1937	------	21	522	747	433	------	------	1,252	1,153	6,751	446	439	11,764
1938	------	340	452	709	578	68	------	2,317	6,359	6,406	422	529	18,180
1939	108	662	566	630	219	3,639	------	1,358	6,430	5,945	381	1,300	21,238
1940	721	815	581	591	199	7,383	74	711	6,547	5,500	468	[1] 2,185	25,775
1941 [2]	1,013	816	332	534	203	7,121	891	497	6,055	5,351	837	[1] 2,677	26,327

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State
[2] Subject to revision

California.—Production in California gained 6,382,000 barrels in 1941 and reached 230,263,000 barrels, or an average of 631,000 daily. Although this is 19,000 barrels above the 1940 average, it is still far below the 1938 figure. About 11,000 barrels of this increase in the daily average is attributable to the reopening of heavy-oil wells—some of them closed for years—whose product is now in demand for naval and industrial fuel. That this developed during the latter half of the

year is indicated by the daily average production of 85,800 barrels of unrefinable crude for this period compared with 63,300 barrels for the first half of the year—the same as for 1940.

Nine hundred and twenty oil wells were completed in 1941 compared with 859 in 1940. The average initial daily production was 712

Production of crude petroleum in California, 1937–41, by districts and fields [1]

[Thousands of barrels]

District and field	1937	1938	1939	1940	1941
San Joaquin Valley:					
Belridge	6,332	5,312	4,781	4,614	4,185
Canal	31	849	1,855	2,034	1,816
Coalinga	5,759	3,898	5,731	9,916	14,224
Coles Levee [2]		12	526	2,589	5,717
Edison	1,577	1,102	838	868	1,013
Elk Hills	3,787	3,887	3,830	4,427	3,491
Fruitvale	3,246	3,078	2,377	2,072	2,085
Greeley	527	1,164	811	1,475	2,480
Kern River	5,639	4,590	4,133	4,082	4,315
Kettleman Hills	29,132	25,609	19,568	16,730	13,983
Lost Hills	1,414	1,297	1,222	1,405	1,263
McKittrick	1,308	1,289	1,326	1,317	1,422
Midway-Sunset	26,485	22,875	18,960	18,397	17,461
Mountain View	6,843	4,033	2,983	2,415	1,910
Mount Poso	6,677	6,235	4,314	3,425	4,117
Rio Bravo	128	1,945	2,875	3,304	4,534
Round Mountain	4,835	5,474	3,528	2,691	2,815
Ten Section	932	2,473	3,247	3,518	5,232
Other San Joaquin Valley	120	273	1,152	2,003	1,748
Total San Joaquin Valley	104,772	95,395	84,057	87,282	93,811
Coastal district:					
Capitan	918	1,067	876	651	740
Elwood	3,203	2,247	1,545	1,286	1,166
Rincon	1,058	1,395	1,238	1,609	1,542
San Miguelito	1,147	1,044	952	1,163	1,427
Santa Maria	3,893	6,128	6,305	2,216	3,183
Santa Maria Valley				6,096	6,908
Ventura Avenue	12,685	12,926	12,935	12,570	12,892
Ventura-Newhall	1,831	1,903	2,317	2,866	4,279
Other Coastal	282	186	132	101	87
Total Coastal	25,017	26,896	26,300	28,558	32,224
Los Angeles Basin.					
Brea Olinda	2,659	2,125	2,063	2,070	2,079
Coyote	4,269	4,354	4,013	4,053	4,466
Dominguez	9,839	9,756	7,131	7,665	8,495
El Segundo	3,632	3,872	1,168	785	527
Huntington Beach	13,255	11,917	9,983	9,592	10,743
Inglewood	5,530	5,337	4,605	4,366	4,901
Long Beach	21,872	20,599	17,004	16,010	14,697
Montebello	3,167	4,147	7,455	7,240	4,884
Playa del Rey	3,181	2,305	1,801	1,498	1,319
Richfield	3,158	3,333	3,134	3,228	2,719
Rosecrans	1,259	3,732	4,459	4,259	3,434
Santa Fe Springs	15,745	12,630	10,050	9,438	8,552
Seal Beach	3,416	3,198	2,641	2,557	2,430
Torrance	2,833	5,203	6,418	4,007	3,210
Wilmington	14,186	34,168	31,100	30,195	30,672
Other Los Angeles Basin	731	782	972	1,078	1,100
Total Los Angeles Basin	108,732	127,458	113,997	108,041	104,228
Total California	238,521	249,749	224,354	223,881	230,263

[1] American Petroleum Institute.
[2] Includes Tupman

barrels compared with 891 in 1940. Dry holes drilled numbered 179—23 more than in 1940.

Production gains were confined to the San Joaquin Valley and Coastal districts; the former increased 6,529,000 barrels and the latter 3,666,000. Production in the Los Angeles Basin declined 3,813,000

barrels. The Wilmington field still led, with an output of 30,672,000 barrels, whereas Kettleman Hills (which in 1940 yielded second place to Midway-Sunset) was exceeded also in 1941 by Long Beach and Coalinga, the latter rising from 9,916,000 barrels in 1940 to 14,224,000 in 1941 compared with a production of only 3,898,000 barrels in 1938.

Ten new fields were discovered in California in 1941, 8 of them in the San Joaquin Valley. The most important was the Raisin City, not because of its production but because it established the presence of oil north of Coalinga, a territory many theretofore had considered barren. Discoveries of the Helm and Riverdale fields later in the year expanded the oil possibilities in this area.

Colorado.—Production in Colorado increased from 1,626,000 barrels in 1940 to 1,875,000 in 1941. Chiefly responsible for this was the Wilson Creek field, where discovery of oil in the Sundance formation raised the output from 237,000 barrels in 1940 to 453,000 in 1941. The Hiawatha gas field, where oil was discovered in June 1940, increased production 116,000 barrels, bringing the yield for this field to 191,000 in 1941.

Only 16 wells were completed during the year, 6 of them small ones in the Rangely field and 3 of them in the Wilson Creek field (the latter averaging 439 barrels a day initial production).

Production of crude petroleum in Colorado, 1937–41, by fields

[Thousands of barrels]

Year	Florence [1]	Fort Collins [2]	Iles	Moffat	Price	Tow Creek	Wilson Creek	Other fields	Total
1937	57	90	1,040	149	173	57		39	1,605
1938	64	109	819	126	185	56		53	1,412
1939	62	116	724	112	289	53		48	1,404
1940	56	128	581	111	326	52	237	[3] 135	1,626
1941 [4]	55	116	547	116	324	50	453	[3] 214	1,875

[1] Includes Canon City.
[2] Includes Wellington.
[3] Includes crude oil consumed on leases and net change in stocks held on leases for entire State
[4] Subject to revision.

Illinois.—Production in Illinois declined from 147,647,000 barrels in 1940 to 134,138,000 in 1941. New discoveries brought the daily average output from 323,900 barrels in February to 423,100 in September, from which it dropped to 397,800 in December—slightly lower than the average for 1940. Federal restrictions on drilling and production, however, indicated that the production in Illinois would be even lower in 1942.

Outstanding in decreased yield was the big Salem field, whose 58-percent decline slashed its output from 70,734,000 barrels in 1940 to 29,539,000 in 1941. Other fields reporting notable declines were the Centralia field, which dropped from 10,642,000 barrels to 3,564,000, and the Louden field, which dropped from 26,596,000 barrels to 22,918,000.

New oil wells numbered 2,730, or 319 less than in 1940, and the initial daily average dropped from 620 barrels in 1940 to 277 in 1941 compared with 285 in 1939.

The Johnsonville field was the outstanding new discovery. The first well in this field was brought in during July, and during the half year 217 oil wells were completed with an average initial daily pro-

duction of 920 barrels. The original production in this field was found in the McClosky sand, but deeper drilling proved the Aux Vases formation productive. The Benton field, discovered in January, produced 5,769,000 barrels from 222 wells completed, with an average daily initial of 285 barrels. It is a significant fact that production in this field is from the Tar Springs formation, which heretofore has been the source of only small wells. The importance of the Benton discovery spurred search for the Tar Springs sand in other parts of the State and resulted in several other discoveries. Although a test of the Devonian lime in the Louden field proved oil in that formation, the quantity was disappointing. The most active field was the New Harmony in White County, where 439 oil wells were completed with an average initial daily production of 161 barrels. Worthy of mention among the new discoveries are the Rising Sun, East Centerville, and Roland fields, also in White County, and the Rural Hill and Woodlawn fields, in Hamilton and Jefferson Counties, respectively.

The Aux Vases sand, prominent in the Salem field, furnished much of the new production in 1941. As mentioned above, it is one of the sources of production in the Johnsonville field, and deeper drilling in the Dale and Hoodville fields to this formation raised the output from 314,000 barrels in 1940 to 2,483,000 in 1941 in the former and from 353,000 to 3,712,000 in the latter. These successes led to other discoveries, as yet too new to be evaluated.

Production of crude petroleum in Illinois, 1937–41, by fields [1]

[Thousands of barrels]

Field	1937	1938	1939	1940	1941
Aden-North		305	794	1, 009	700
Albion				1, 095	895
Benton					5, 769
Boyleston			169	1, 306	815
Centralia	5	3, 022	2, 265	10, 642	3, 564
Cisne	20	421	1, 224	479	219
Clay City	1, 556	4, 005	7, 694	6, 922	4, 680
Dale				314	2, 483
Dundas			209	2, 341	4, 438
Hoodville				353	3, 712
Iron				1, 120	801
Irvington				509	1, 037
Johnsonville					5, 913
Keensburg			987	2, 709	2, 002
Louden		1, 892	18, 351	26, 596	22, 918
Mount Carmel				26	1, 691
New Harmony			5	1, 503	9, 939
Noble	947	4, 232	1, 644	2, 744	2, 507
North Boos				249	826
Rural Hill					1, 570
Salem		2, 895	50, 179	70, 734	29, 539
Sandoval	24	15	696	704	449
St. James		48	439	1, 713	1, 871
Storms			42	1, 514	1, 398
Tonti			835	2, 556	1, 250
Woodlawn					2, 465
Old eastern fields	4, 271	3, 926	2, 738	3, 329	3, 989
Other fields	706	1, 588	3, 663	5, 984	11, 191
	7, 529	22, 349	91, 934	146, 451	128, 634

[1] Oil and Gas Journal.

Indiana.—New discoveries in Indiana raised the production from 4,978,000 barrels in 1940 to 6,634,000 in 1941. More than half of the output, however, came from the Griffin field, and it was the scene of the greatest drilling activity.

Two hundred and sixty-two oil wells were completed averaging 109 barrels initial daily production compared with 231 completions and 139 barrels initial production in 1940; 128 of the completions were in the Griffin field and 25 in the New Harmony.

Production of crude petroleum in Indiana, 1937–41, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937	60	65	69	69	72	75	75	75	72	70	67	75	844
1938	68	72	75	75	80	88	90	94	90	88	85	90	995
1939	59	59	59	65	87	114	135	166	176	230	262	299	1,711
1940	203	235	329	314	337	366	400	505	516	583	609	581	4,978
1941 [1]	617	574	556	554	545	530	567	558	532	534	489	578	6,634

[1] Subject to revision.

Kansas.—Production in Kansas established a new record in 1941, when a 26-percent gain over 1940 raised the output to 83,261,000 barrels compared with the previous peak of 70,761,000 barrels in 1937. The increased output was in response to a greater demand to replace declining production in Illinois and Oklahoma and was made possible by the expansion of pipe-line facilities in Kansas. Production

Production of crude petroleum in Kansas, 1937–41, by counties and selected fields [1]

[Thousands of barrels]

County and field	1937	1938	1939	1940	1941
Barton:					
Silica-Raymond	7,618	5,534	5,000	5,763	7,615
Other fields	2,505	2,739	3,109	3,344	5,087
Butler:					
Eldorado	3,340	3,023	2,710	2,651	2,597
Other fields	2,649	2,671	2,353	2,394	2,633
Cowley	1,963	2,318	2,131	2,672	2,802
Ellis:					
Bemis-Walters	2,184	2,826	2,881	3,419	4,866
Burnett	1	36	254	1,771	3,291
Other fields	444	254	332	342	477
Ellsworth	1,972	1,140	1,021	1,603	2,900
Greenwood	4,007	3,834	3,793	3,227	3,238
Harvey:					
Hollow-Nikkel	1,112	773	738	511	513
Other fields	447	308	244	176	166
McPherson:					
Bornholdt-Welch	112	173	198	1,029	1,783
Graber-Hesston	1,233	1,082	965	947	951
Ritz Canton	1,872	1,650	1,753	1,373	1,366
Voshell	931	765	574	562	586
Other fields	415	335	377	400	600
Reno:					
Burrton	5,384	3,521	3,187	2,625	2,539
Other fields	1,442	776	770	634	675
Rice:					
Chase-Campbell	3,591	2,127	2,256	2,338	2,746
Geneseo-Edwards	1,292	1,427	1,753	1,814	2,694
Other fields	3,438	1,744	1,695	1,653	1,457
Russell.					
Hall-Gurney	594	613	1,211	2,243	3,520
Trapp-Sellens	4,105	4,162	4,255	5,481	7,577
Other fields	6,766	5,081	4,272	4,709	4,826
Sedgwick	1,545	1,418	1,247	1,156	1,093
Stafford:					
Zenith		365	1,294	1,838	3,176
Other fields	1,098	992	1,074	1,361	2,164
Sumner	2,342	1,698	1,494	1,220	977
Other counties	3,952	4,769	5,188	5,790	7,506
	68,354	58,154	58,129	65,046	82,421

[1] Oil and Gas Journal.

in Kansas has been restricted because of inadequate transportation facilities; but with the pressure of demand many pipe lines have been looped to enlarge their capacity, and new lines have been installed to fields not having that type of transportation in the past.

There were 1,420 wells drilled with an average initial daily production of 1,032 barrels compared with 1,410 wells drilled in 1940 with an average initial of 460 barrels. The number of wells increased from 20,655 to 21,838, according to the Oil and Gas Journal.

Reno and Stafford Counties led in development during 1941. Success of 80 wells completed in the Zenith field with an average initial daily production of 1,510 barrels spurred further exploration, leading to the discovery in July of the Peace Creek field, where 18 wells were completed with an average initial daily production of 2,830 barrels. The productive area was increased further by discovery of the Hendrickson pool in December. Production in these fields is from the Viola lime and overlying Misener sand. Discovery of oil in August in far western Kearny County in a stray Pennsylvanian sand, distant from any other production, was one of the most significant developments of the year because of the new possibilities it revealed.

Kentucky.—Crude-oil production in Kentucky continued to decline, dropping to 4,762,000 barrels in 1941 from 5,188,000 in 1940. Completions numbered 233 compared with 224 in 1940. The only development of interest in the State was the discovery of the Ordovician formation at Sinking Creek which resulted in some leasing activity and hopes for future production.

Production of crude petroleum in Kentucky, 1937–41, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937	400	409	494	476	491	498	487	472	448	436	436	437	5,484
1938	411	406	457	432	459	487	506	553	547	526	514	523	5,821
1939	536	380	437	418	494	527	503	539	423	443	472	449	5,621
1940	383	422	435	438	442	405	454	449	444	464	424	428	5,188
1941 [1]	424	387	414	407	403	385	418	386	391	397	356	394	4,762

[1] Subject to revision.

Louisiana.—Kansas and Texas were the only States where production increased more than it did in Louisiana. The gain of 12,324,000 barrels—12 percent—raised the output to 115,908,000 barrels compared with 103,584,000 in 1940.

Despite a year of drilling activity, production in northern Louisiana increased only from 24,406,000 barrels in 1940 to 25,354,000 in 1941. The Rodessa field continued to decline but retained first place, and the Olla field, discovered in 1940, crossed the 4-million barrel mark to rank as second-largest in the northern part of the State. The Lisbon field, which ranked third in 1938 with over 3 million barrels production, dropped to less than 1 million in 1941.

The Cotton Valley field, ranking second in this area in 1940 but displaced by Olla in 1941, did not decline as the statistics seem to indicate. After completion of a large recycling plant in this field in July 1941 the condensate formerly included with crude-oil production was segregated into the individual products. In addition to the 3,459,000 barrels of crude oil produced from this field in 1941, con-

densate and natural-gasoline output totaled 2,186,000 barrels and butanes plus other products, 109,000 barrels; in 1940, 211,000 barrels of natural gasoline and condensate were produced separately, and crude-oil output, including condensate, totaled 5,189,000 barrels.

Production of crude petroleum in Louisiana, 1937–41, by districts and fields

[Thousands of barrels]

District and field	1937	1938	1939	1940	1941 [1]
Gulf Coast:					
Anse la Butte	70	74	24	380	1,446
Black Bayou	1,313	1,285	1,048	1,007	838
Bosco	3,020	2,085	1,737	1,718	1,494
Caillou Island	6,402	6,249	4,078	2,493	2,002
Cameron Meadows	1,490	1,279	782	665	810
Charenton	236	1,085	2,425	2,724	1,849
English Bayou	2,871	2,176	1,613	1,565	1,301
Eola			943	3,935	3,668
Garden Island	606	828	591	1,106	1,225
Gibson	453	984	1,128	1,335	1,407
Golden Meadows		1	739	4,074	4,814
Grand Bay		50	496	1,168	2,022
Grand Lake			130	1,417	1,625
Hackberry	4,592	3,728	3,216	3,312	3,768
Iowa	6,383	5,641	4,436	3,475	3,400
Jeanerette	2,277	2,485	1,772	1,203	975
Jennings	2,996	7,537	8,119	5,505	4,991
Lafitte	4,136	5,862	4,745	4,602	4,523
Lake Barre	1,368	657	347	317	219
Leeville	2,629	1,867	1,303	1,135	1,597
New Iberia	6,231	5,339	4,204	3,076	2,760
North Crowley	30	362	827	1,602	2,004
Port Barre	600	612	681	810	1,025
Quarantine Bay	1	261	901	1,585	2,311
Roanoke	1,890	1,339	1,076	965	851
Sulphur	1,414	1,244	1,381	970	921
Sweet Lake	294	307	385	532	764
Tepetate	2,158	1,985	2,033	1,656	1,481
University		170	1,444	3,496	3,591
Valentine	968	1,691	1,127	877	512
Venice	149	492	515	855	1,163
Ville Platte	3	850	3,352	4,493	6,119
White Castle	490	593	628	806	922
Other Gulf Coast	6,971	7,512	10,017	[2] 14,319	[2] 22,156
Total Gulf Coast	62,041	66,630	68,243	79,178	90,554
Northern					
Caddo	2,353	2,659	2,663	2,912	3,077
Cotton Valley	1,151	3,527	4,384	5,189	3,459
Haynesville	1,143	1,107	1,064	987	956
Homer	932	952	988	1,041	1,033
Lisbon	2,490	3,368	1,693	1,482	896
Nebo [3]				54	974
Olla [4]				942	4,641
Rodessa	18,050	13,443	9,042	6,859	5,212
Shreveport		131	1,840	1,555	1,011
Urania	1,085	1,003	974	869	832
Other Northern	1,679	2,388	2,755	[2] 2,516	[2] 3,263
Total Northern	28,883	28,578	25,403	24,406	25,354
Total Louisiana	90,924	95,208	93,646	103,584	115,908

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[3] Includes Hemphill and Trout Creek.
[4] Includes Little Creek and Summerville.

There were 467 oil-well completions in northern Louisiana in 1941 with an average initial daily production of 106 barrels compared with 448 completions with an average initial of 114 barrels in 1940. Greatest activity was in the Caddo field, where 163 wells were completed with an initial daily production of 57 barrels. Next greatest activity was in the 1940 discoveries—the Olla and Nebo fields producing from the Eocene Wilcox sands in La Salle Parish with 92 completions

averaging 137 barrels daily in the former and 71 completions averaging 153 barrels daily in the latter. Further drilling in these sands discovered new fields the latter part of the year at a deeper level. The Wilcox trend is developing into one of the most important sources of production in northern Louisiana as well as upper Gulf Coast Texas. An important discovery late in the year was production in the Pettit lime in the old Haynesville pool in Claiborne Parish.

Production in the Louisiana Gulf Coast district rose from 79,178,000 barrels in 1940 to 90,554,000 in 1941. This gain was widespread, and the output in 6 parishes increased more than 1 million barrels each. The greatest advance was in Plaquemines Parish, where production rose from 5,162,000 barrels in 1940 to 8,788,000 in 1941. The average initial daily production from the 67 wells drilled in this parish was 361 barrels. Grand Bay and West Bay fields were 1941 discoveries in Plaquemines Parish, with 12 completions having an initial daily production of 313 barrels in the former and 13 completions having an initial daily production of 386 barrels in the latter. Ville Platte, in Evangeline Parish, had the greatest increase of any one field, the output of 6,119,000 barrels compared with 4,493,000 in 1940 identifying it as the largest field in the State. The average initial daily production for the 65 wells drilled in this field was 230 barrels. Production from this field comes principally from the Wilcox trend. Jennings, highest producing pool in 1940, dropped to second place in 1941, being exceeded by Ville Platte only.

There were 614 oil-well completions in the Louisiana Gulf Coast district, with an average initial daily production of 252 barrels compared with 741 completions with an average initial of 307 barrels in 1940. Sixteen new fields were found; the most important were Bayou Sale in St. Mary Parish and St. Gabriel in Iberville Parish.

Michigan.—The decline in production from the large Michigan fields was so precipitous that despite many new discoveries the output dropped from 19,753,000 barrels in 1940 to 16,361,000 in 1941. Production in the Redding field dropped from 3,986,000 barrels to 1,749,000, and in the Walker field from 4,218,000 barrels to 1,292,000, in addition to declines of sizable proportions in many other fields. New discoveries during the year, however, reversed the trend, so that December production was almost half again as much as that of January, giving the prospect that the output in 1942 probably would exceed that of 1941.

Four hundred and thirty-three oil wells were completed in 1941 with an average initial daily production of 1,131 barrels, compared with 536 completions with an average initial of only 215 barrels in 1940.

The Reed City field, discovered in Osceola County late in 1940, had the greatest activity when deep drilling about the middle of the year revealed a large pool in the Monroe and Traverse formations. There were 113 wells completed in this field, with an average initial daily production of 3,511 barrels, and the pool supplied 2,754,000 barrels of the State production.

Oil was discovered in the Headquarters pool, Roscommon County, in June, and during the rest of the year 12 wells were completed with an average initial daily production of 3,695 barrels. Notwithstanding 77 completions in Allegan County, production dropped from 2,710,000 barrels in 1940 to 1,440,000 in 1941. Twenty-four completions in Arenac County caused a gain in production from the

Adams pool from 313,000 barrels in 1940 to 1,118,000 in 1941. The Winterfield pool, brought in as a gas field in Clare County in 1940, yielded 1,101,000 barrels of oil in 1941. The 30 wells drilled in this county had an average initial daily production of 424 barrels. Although there were numerous other discoveries, they seemed of minor importance.

Production of crude petroleum in Michigan, 1937–41, by fields [1]

[Thousands of barrels]

Year	Adams	Bloomingdale	Buckeye	Clayton	Porter	Redding	Reed City	Sherman	Walker	Winterfield	Other fields	Total
1937	13		6,428	1,030	2,707			1,532			4,918	16,628
1938	53	514	7,385	1,071	1,798	874		1,152	1		5,897	18,745
1939	54	3,371	2,502	638	1,331	3,083		433	2,821		9,229	23,462
1940	313	1,001	1,004	410	1,234	3,986	2	461	4,218	8	7,116	19,753
1941	1,118	529	665	254	1,136	1,749	2,754	288	1,292	1,101	5,475	16,361

[1] Data from Department of Conservation, Michigan.

Mississippi.—Youngest except one among the country's oil-producing States, at the end of 1941 Mississippi had taken the rank of ninth-largest, and the rapid expansion of its output indicated that it would soon reach seventh place. Total production for 1941 was 15,314,000 barrels compared with 4,400,000 in 1940. Most of this came from the Tinsley field, although the Pickens field was the source of a small amount.

There were 219 oil-well completions averaging 589 barrels initial daily production compared with 107 completions averaging 554 barrels initial production in 1940. All but two of these wells were drilled on the Tinsley dome, extending it and discovering production in newer zones. Seven producing zones have now been established in the field. The other two completions were discovery wells in new fields. One in Sharkey County, discovered in October, seems of little importance; but the other, discovered in Madison County in December, had a large initial daily production and caused immediate activity in the area.

Production of crude petroleum in Mississippi, 1939–41, by months

[Thousands of barrels]

Year	Jan.	Feb	Mar	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1939									5	17	32	53	107
1940	117	189	235	231	252	317	276	578	761	480	448	516	4,400
1941 [1]	541	603	570	767	901	858	1,425	1,598	1,694	1,932	2,240	2,185	15,314

[1] Subject to revision

Montana.—Production in Montana continued to increase, rising from 6,728,000 barrels in 1940 to 7,526,000 in 1941. Although production for the entire State increased 798,000 barrels, that of the Cut Bank field rose 929,000 barrels to total 5,020,000, representing 67 percent of Montana's total. Despite active drilling and a new discovery on the west side, production from the Kevin-Sunburst field declined from 1,923,000 barrels to 1,753,000. All drilling activity

except one well completed in the Frannie field was concentrated in the Cut Bank and Kevin-Sunburst fields. Extension of the west and south sides of the Cut Bank field brought in 111 new wells with an average initial daily production of 177 barrels, and 48 wells were completed in the Kevin-Sunburst field with an average initial of 111 barrels.

Production of crude petroleum in Montana, 1937–41, by fields

[Thousands of barrels]

Year	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Frannie	Kevin-Sunburst	Lake Basin	Pondera	Other fields	Total
1937	227	3,332	102	12		1,634	(1)	418	80	5,805
1938	211	2,809	365	8		1,290	18	210	35	4,946
1939	196	3,545	319	14		1,576	18	276	16	5,960
1940	187	4,091	175	16	5	1,923	18	305	8	6,728
1941 [2]	173	5,020	170	17	26	1,753	17	286	[3] 64	7,526

[1] Included under "Other fields."
[2] Subject to revision.
[3] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

Nebraska.—Crude-oil production in Nebraska became significant in 1941, when it amounted to 1,636,000 barrels compared with 276,000 in 1940. Most of this oil came from the Falls City pool. Completions numbered 38, with an average initial daily production of 360 barrels.

New Mexico.—The 39,369,000 barrels produced in New Mexico in 1941 was only a slight increase over the 1940 yield. The declining Monument and Eunice fields still maintained the lead, both having gained slightly over their 1940 output. Identified with these fields, the Arrowhead field, discovered in 1940, increased its production over one-half million barrels to 1,429,000. The south Maljamar field, however, increased from 760,000 barrels in 1940 to 1,651,000 in 1941 for the largest gain of any field. There were 63 completions in this field, with an average initial daily production of 361 barrels. Production from the Loco Hills field increased almost 350,000 barrels.

Oil-well completions numbered 209, with an average initial daily production of 221 barrels in 1941 compared with 479 completions with an average initial production of 345 barrels in 1940.

Production of crude petroleum in New Mexico, 1937–41, by districts and fields [1]

[Thousands of barrels]

Year	Northwest			Southeast						Total
	Hogback	Rattlesnake	Other Northwest	Artesia [2]	Eunice	Hobbs	Monument	Vacuum	Other Southeast	
1937	70	283	31	1,986	11,043	7,310	10,968	7	6,740	38,438
1938	70	245	29	2,188	8,966	5,040	9,451	886	9,134	36,009
1939	69	204	30	1,981	7,863	4,401	8,206	3,028	11,886	37,668
1940	74	143	37	2,686	6,561	3,785	6,887	4,738	13,846	38,757
1941 [3]	73	97	36	3,433	6,658	3,686	6,960	4,800	13,917	39,660

[1] Oil and Gas Journal.
[2] Includes Grayburg, Jackson, and Maljamar.
[3] Subject to revision.

New York.—Production in New York increased from 4,999,000 barrels in 1940 to 5,185,000 in 1941, the largest output since 1937. Production was encouraged by the strong demand for lubricating oil, which in June took the price of Bradford crude to $2.75 per barrel—the "ceiling" imposed for this crude by the Price Administrator.

According to the Oil Weekly, new completions numbered 674, with an average initial daily production of 7 barrels. Repressuring operations were active, and 441 wells were drilled for water input.

Production of crude petroleum in New York, 1937–41, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937	440	408	467	455	461	481	484	469	453	444	453	463	5,478
1938	444	409	455	429	447	418	404	429	406	404	391	409	5,045
1939	402	363	418	406	439	435	416	441	434	448	453	443	5,098
1940	458	430	438	444	439	402	425	396	383	408	379	397	4,999
1941 [1]	424	372	410	436	435	422	456	438	445	465	414	468	5,185

[1] Subject to revision.

Ohio.—Production in Ohio totaled 3,340,000 barrels in 1941 compared with 3,159,000 in 1940. Oil-well completions numbered 419, with an initial daily production of 27 barrels, compared with 323 completions in 1940.

Greatest activity was in Medina County, where 132 small wells were completed, but the principal development was in Perry County, with 67 new wells. Of these, 45 with an average initial daily production of 152 barrels from the Clinton sand extended the Clayton pool. Eight wells were drilled in the northwestern part of the county, with an average initial daily production of 120 barrels.

Production of crude petroleum in Ohio, 1937–41, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937	255	282	316	304	308	317	314	312	332	262	272	285	3,559
1938	248	258	301	274	281	286	266	301	277	278	257	271	3,298
1939	252	236	274	255	288	272	269	266	247	276	260	261	3,156
1940	207	234	246	264	280	260	286	287	272	296	248	279	3,159
1941 [1]	263	245	258	281	285	284	283	270	287	300	276	308	3,340

[1] Subject to revision

Oklahoma.—Notwithstanding great drilling activity, production in Oklahoma continued to decline and dropped to 154,759,000 barrels in 1941 compared with 156,164,000 in 1940 and 228,839,000 in 1937. Decreases in the Oklahoma City field output from 35,970,000 barrels in 1940 to 32,184,000 in 1941, and in the Seminole field from 26,989,000 barrels to 23,687,000, along with losses in smaller fields, more than offset the yield from new wells. The Fitts field, which produced more than Seminole in 1937, was down to 4,223,000 barrels in 1941.

Completions in 1941 totaled 1,099, with an average initial daily production of 226 barrels compared with 1,011 wells with an average initial of 204 barrels in 1940. The most important discovery was the Apache field in Caddo County in June, where the seven wells drilled

had an average initial daily production of 4,012 barrels from the Simpson sand. Most of the yield increases were in fields discovered before 1941. The Hewitt field, which has been producing for several years, had the greatest activity, as 119 wells were completed, mostly in the first half of the year. Their average initial daily production was 294 barrels, and the output in this field increased from 1,778,000 barrels in 1940 to 4,860,000 in 1941. Production in the Cumberland field increased from 393,000 barrels in the discovery year 1940 to 2,543,000 barrels in 1941. Completions in this field were 31, with an average initial daily production of 266 barrels. New completions also resulted in increased production in the Cement and Dill fields.

Production of crude petroleum in Oklahoma, 1937–41, by fields [1]

[Thousands of barrels]

Field	1937	1938	1939	1940	1941
Allen	2,511	2,475	2,289	2,066	1,780
Beebe	928	1,017	1,005	1,828	1,526
Billings	2,349	2,108	2,178	2,209	2,276
Bristow-Slick	2,790	2,389	2,403	2,213	1,951
Burbank	2,871	2,814	2,689	2,838	3,282
Cement	782	1,336	1,826	2,469	3,354
Coyle			386	637	1,468
Crescent	3,852	1,687	983	769	576
Cromwell	1,265	1,288	1,175	1,357	1,457
Cumberland				393	2,543
Cushing-Shamrock	3,908	3,848	3,446	3,353	3,223
Dill	640	405	358	635	1,426
Edmond	5,884	2,030	1,675	1,488	1,224
Fish	2,077	1,224	1,376	1,153	1,359
Fitts	30,977	16,655	9,120	6,246	4,223
Healdton	3,654	3,401	3,236	3,177	3,086
Hewitt	1,583	1,400	1,362	1,778	4,860
Keokuk	2,979	1,713	1,176	1,091	1,029
Lucien	5,047	3,324	3,017	2,750	2,067
Nowata County	3,450	4,390	4,348	4,306	3,995
Oklahoma City	54,776	38,796	35,728	35,970	32,184
Olympic	4,315	1,889	1,034	739	598
Osage (outside Burbank-South Burbank)	7,626	6,438	6,063	5,904	6,131
Ramsey		528	1,489	1,377	1,549
Seminole field:					
Bowlegs	4,178	3,200	2,678	2,464	2,134
Carr City	1,973	1,294	922	840	791
Earlsboro	2,945	3,751	3,590	3,730	3,757
Konawa	592	569	656	766	1,245
Little River	4,222	3,040	2,865	2,875	2,705
St. Louis-Pearson	7,528	7,766	11,303	9,331	6,997
Seminole City	3,428	2,842	2,618	2,501	2,243
Other Seminole districts	5,838	6,390	5,310	4,482	3,815
Total Seminole field	30,704	28,852	29,942	26,989	23,687
Sholem-Alechem-Tatums-Tussy	3,129	2,249	1,699	2,169	2,826
South Burbank	5,579	3,938	3,150	2,927	2,780
Other fields	39,431	32,271	30,331	31,936	36,797
Total Oklahoma	223,107	168,465	153,484	150,767	153,257

[1] Oil and Gas Journal.

Pennsylvania. Despite heavy demand, crude-oil production slumped from 17,353,000 barrels in 1940 to 16,750,000 in 1941. The trend, however, was definitely upward the last 4 months of the year, as the output for this period was 6 percent higher than for the same period in 1940. Most of the drilling was in the Bradford district, where 1,540 wells were drilled with an average initial daily production of 1.2 barrels.

Consideration of intensive recovery methods in Pennsylvania has brought interest in horizontal wells in addition to the established practice of repressuring wells. Water-input wells drilled for this purpose numbered 1,675 in 1941.

Production of crude petroleum in Pennsylvania, 1937–41, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937	1,497	1,390	1,584	1,554	1,581	1,613	1,689	1,703	1,678	1,652	1,608	1,640	19,189
1938	1,566	1,466	1,653	1,497	1,517	1,432	1,385	1,460	1,377	1,383	1,318	1,372	17,426
1939	1,346	1,255	1,437	1,411	1,558	1,437	1,405	1,479	1,414	1,570	1,532	1,538	17,382
1940	1,522	1,505	1,530	1,582	1,585	1,335	1,418	1,387	1,321	1,405	1,319	1,444	17,353
1941 [1]	1,416	1,231	1,336	1,382	1,407	1,345	1,419	1,376	1,440	1,501	1,370	1,527	16,750

[1] Subject to revision.

Texas.—Texas production of 507,584,000 barrels was the greatest since 1937 and represented 14,375,000 barrels more than the 1940 output. The only districts to show material gains were the Gulf Coast and West Texas, and the greatest loss was in the declining East Texas, although it maintained its place as the greatest field in the world. Development of the Wilcox trend in the upper Gulf Coast district and of deeper sands in West Texas is responsible for the increases. In all, 7,262 oil wells were completed in 1941, with an average initial daily production of 373 barrels, compared with 6,632 completions with an average of 486 barrels in 1940.

Production in the Gulf Coast district increased from 122,166,000 barrels in 1940 to 135,139,000 in 1941, owing principally to development of the Wilcox trend in the upper Gulf Coast area. Although oil was discovered several years ago in the Eocene Wilcox Sand, it was not until 1939 that active development began, and the rewards have come in 1940 and 1941.

The Conroe field gained 2,327,000 barrels, maintaining its place as the largest producer in the Texas Gulf Coast field with a total output of 11,630,000 barrels. Hastings, with a gain of 2,202,000 barrels, produced 7,623,000 barrels, but Saxet-Saxet Heights, displaced by Hastings, dropped from 5,634,000 barrels in 1940 to 4,578,000 in 1941. Development of the Marginulina-Frio sands in Jackson County resulted in large gains in the Lolita and West Ranch fields.

There were 1,353 oil wells completed in the Gulf Coast area, with an average initial daily production of 196 barrels, compared with 1,072 completions having an initial production of 276 barrels in 1940. Greatest activity was in the West Ranch and Lolita fields, where 133 and 113 wells were completed with an average initial daily production of 243 and 196 barrels, respectively. Wells with the largest average initial daily production were in the Tom O'Connor field—19 with 548 barrels average; Fannett—16 with 539 barrels average; Anahuac—23 with 499 barrels average; and West Columbia—26 with 328 barrels average.

Production in West Texas increased from 84,494,000 barrels in 1940 to 92,907,000 in 1941. The Slaughter district had the largest gain, and Wasson and Cowden, the largest producing districts, ranked next in reverse order. There were 2,123 oil wells completed in West Texas with an average initial daily production of 841 barrels compared with 1,717 completions in 1940 averaging 891 barrels. Output from the Slaughter district, northernmost field in West Texas and the most active drilling center in the Nation in 1941, rose from 841,000 barrels in 1940 to 4,612,000 in 1941. Oil-well completions numbered 634, with an average initial daily production of 1,051 barrels. There were 284 wells drilled in the Wasson district, largest producing district in West Texas, averaging 692 barrels initial production. The North

Cowden, Foster, and Johnson fields in the Cowden district all showed large increases, and 120 new wells in Seminole almost tripled the output from that field.

Despite great drilling activity, increased production from several fields, and the discovery of a new large field, yield from the eastern part of Texas dropped from 168,919,000 barrels in 1940 to 161,634,000 in 1941, owing principally to declines in the East Texas, Van, and Rodessa fields, whereas increases in Long Lake, Cayuga, and Talco, plus the output from the new Hawkins field, helped to stem the drop. In all, 798 wells were completed with an average initial daily production of 160 barrels.

The Hawkins field, discovered in the last days of 1940, produced 1,432,000 barrels of oil in 1941 from the 226 wells completed during the year, with an average initial daily production of 348 barrels.

Although there was a great amount of drilling activity in North Texas in 1941, production was little changed from that of 1940. There were 2,456 wells drilled of which 1,593 were oil completions. A number of new pools were discovered, and new production was found in deeper formations, particularly the Ellenburger. There were 268 completions to this formation in the K. M. A. field, with an average initial daily production of 326 barrels. Ninety-five wells completed in the Hull-Silk field raised its production more than a million barrels—the only field in North Texas to have a large gain.

Although 648 wells were completed in the Panhandle, no unusual developments or new discoveries were made. There was a small gain in production.

Production of crude petroleum in Texas, 1937–41, by districts and fields

[Thousands of barrels]

District and field	1937	1938	1939	1940	1941 [1]
Gulf Coast:					
Anahuac	4,318	2,887	2,604	2,683	4,657
Barbers Hill	4,366	3,413	3,165	3,180	3,076
Conroe	15,191	11,606	9,320	9,303	11,630
Dickinson-Gillock	1,432	2,227	2,946	2,940	2,191
Fairbanks	----	839	2,668	2,460	2,932
Flour Bluff	1,607	1,736	1,362	1,151	1,336
Friendswood	88	1,078	2,323	2,542	2,959
Goose Creek	860	596	619	571	509
Greta	6,635	4,190	1,993	1,493	2,357
Hardin	241	1,621	2,180	1,646	1,659
Hastings	5,835	6,940	6,354	5,421	7,623
Heyser	1,515	3,051	3,470	3,399	2,633
High Island	1,183	900	866	966	985
Hull	2,492	2,899	2,077	2,005	2,387
Humble	1,217	1,202	1,041	957	913
Lovell's Lake	----	51	245	882	1,334
Luby	80	1,578	2,472	1,459	1,396
Manvel	3,458	3,222	2,718	2,627	1,915
Old Ocean	447	1,782	3,209	4,165	4,741
Orange	248	483	887	889	862
Pierce Junction	1,243	1,117	897	628	637
Placedo	3,082	3,088	2,298	1,882	1,401
Raccoon Bend	2,002	1,206	1,034	1,232	1,329
Refugio	2,307	2,093	2,097	2,111	2,223
Saxet-Saxet Heights	15,763	13,130	8,953	5,634	4,578
Segno	472	708	958	1,606	1,538
Spindletop	912	837	782	609	486
Sugarland	1,322	1,222	1,242	1,354	647
Thompsons	4,147	3,998	4,617	4,384	4,609
Tomball	3,060	2,635	2,630	2,675	3,314
West Beaumont	(2)	571	1,033	1,149	821
West Columbia	825	1,600	2,261	2,353	2,740
West Ranch	----	19	280	1,862	3,691
White Point	20	387	2,089	3,054	2,864
Withers	570	925	1,330	1,712	2,829
Other Gulf Coast	27,764	29,750	37,503	[3] 39,182	[3] 43,337
Total Gulf Coast	114,702	115,587	122,523	122,166	135,139

See footnotes at end of table

Production of crude petroleum in Texas, 1937–41, by districts and fields—Continued

[Thousands of barrels]

District and field	1937	1938	1939	1940	1941 [1]
East Texas:					
East Texas proper [4]	170,673	152,116	144,615	141,023	132,586
Cayuga	3,195	3,191	3,472	4,432	4,859
Hawkins					1,432
Long Lake	549	721	867	828	1,375
Rodessa	12,626	11,373	9,785	6,607	4,712
Sulphur Bluff	1,627	1,653	1,536	1,522	1,582
Talco	9,720	9,593	9,609	8,818	9,038
Van	11,346	5,630	5,333	4,512	3,739
Other East Texas	589	611	738	1,177	2,311
Total East Texas	210,325	184,888	175,955	168,919	161,634
Central Texas:					
Darst Creek	2,802	2,816	2,707	2,178	1,845
Luling	2,260	2,497	2,443	2,256	1,974
Lytton Springs	120	1,057	867	649	577
Mexia [5]	1,678	1,635	1,494	1,418	1,531
Pettus	3,135	2,088	1,515	1,276	1,061
Salt Flat (Bruner)	1,586	1,419	1,594	1,512	1,348
Other Central Texas	1,990	1,175	1,049	1,139	1,256
Total Central Texas	13,571	12,687	11,669	10,428	9,592
North Texas [6]	37,580	36,823	40,371	[7] 48,153	[7] 48,568
Panhandle [8]	27,617	23,556	24,165	26,716	27,831
South Texas [9]	30,780	29,597	29,392	32,333	31,913
West Texas:					
Andrews County	1,318	1,309	1,587	1,506	2,224
Big Lake	2,648	2,381	2,275	2,075	1,938
Fisher County	1,164	1,208	1,059	835	655
Slaughter		73	416	841	4,612
Ward County	12,561	8,878	7,795	7,580	7,189
Other West Texas	58,052	58,863	66,321	[3] 71,657	[3] 76,289
Total West Texas	75,743	72,712	79,453	84,494	92,907
Total Texas	510,318	475,850	483,528	493,209	507,584

[1] Subject to revision.
[2] Included under "Other Gulf Coast."
[3] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[4] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[5] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[6] Includes the fields in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[7] Includes crude oil consumed on leases and net change in stocks held on leases for East Texas, exclusive of East Texas proper, Central, North, and South Texas.
[8] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[9] Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.

West Virginia.—The output of 3,433,000 barrels in 1941 was slightly less than the 3,444,000 barrels produced in 1940, but the trend was upward, as production in the last 4 months of 1941 was 2 percent higher than that for 1940.

There were 115 new wells drilled, with an average initial daily production of 15 barrels.

Production of crude petroleum in West Virginia, 1937–41, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937	289	292	340	330	325	333	329	323	327	324	307	326	3,845
1938	290	294	337	317	322	326	304	325	315	320	257	277	3,684
1939	279	282	312	288	320	309	288	310	290	309	282	311	3,580
1940	234	301	285	300	311	276	303	291	286	312	264	281	3,444
1941 [1]	286	249	276	300	290	280	297	283	289	311	270	302	3,433

[1] Subject to revision.

Wyoming.—Production rose from 25,711,000 barrels in 1940 to 29,694,000 in 1941. The greatest gain was in the Lost Soldier field, where the output rose from 2,070,000 barrels in 1940 to 4,745,000 in 1941. Seven wells were completed in this field, with an average initial daily production of 784 barrels. A 63-percent gain raised production in the Grass Creek field from 718,000 barrels to 1,171,000, although no new completions were reported.

There were 123 oil wells completed during 1941 but no new fields were found. Drilling was most active in Lance Creek, where 26 wells were brought in with an average initial daily production of 608 barrels, notwithstanding which production dropped from 9,121,000 barrels to 8,838,000. Production in La Barge field rose from 585,000 barrels to 769,000, in consequence of 16 completions; 13 wells were completed in the Osage field and 11 in Oregon Basin. Production in the latter field rose from 2,725,000 barrels to 3,197,000.

Production of crude petroleum in Wyoming, 1937–41, by fields

[Thousands of barrels]

Year	Big Muddy	Byron-Garland	Elk Basin	Frannie	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome	Lost Soldier-Ferris
1937	484	1,248	104	358	654	437	423	4,247	329	511
1938	441	836	94	419	513	346	395	4,846	306	1,037
1939	435	867	203	496	844	240	379	6,884	278	1,592
1940	429	1,411	190	812	718	353	585	9,121	290	2,070
1941 [1]	421	1,516	195	939	1,171	264	767	8,838	309	4,745

Year	Medicine Bow	Oregon Basin	Osage	Poison Spider-South Casper	Quealy	Rock Creek	Salt Creek	Other fields	Total
1937	1,344	1,407	261	230	268	748	5,874	239	19,166
1938	1,040	1,648	116	196	271	640	5,705	173	19,022
1939	544	1,848	132	26	225	1,008	5,331	122	21,454
1940	251	2,725	59	238	172	928	5,201	[2] 158	25,711
1941 [1]	245	3,197	132	251	158	952	5,146	[2] 448	29,694

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire State

WELLS

The lethargy in drilling that set in during June 1940 continued well into 1941 and oil-well completions in March 1941 were 382 less than in March 1940. However, an increase of 335 completions in July 1941 over those for June indicated the effect of the price increases earlier in the year and prompted new activity that raised the total of oil wells completed during the year to 19,195—70 more than in 1940 (see fig. 4). The total for the year was exceeded only in 1920 and 1937.

Total completions in 1941, including oil and gas wells and dry holes, were almost 1,000 more than in 1940—29,070 compared with 28,124. Industrial needs for gas resulted in an increase of 608 gas-well completions to 2,990, and dry holes drilled increased 268 to total 6,885. The proportion of oil wells to total completions dropped about 2 percent; that of gas wells increased about 2 percent; and that of dry wells remained virtually the same.

The 1,054 dry wells drilled in North Central Texas—37 percent of all completions in that area—indicate the great amount of wildcat activity in this area. Illinois had the next largest number—890—but they represented only 25 percent of total completions. Michigan's 419 dry wells, representing 45 percent of the total completions, was the largest proportion, and Ohio's 502 dry wells represented 30 percent of the completions.

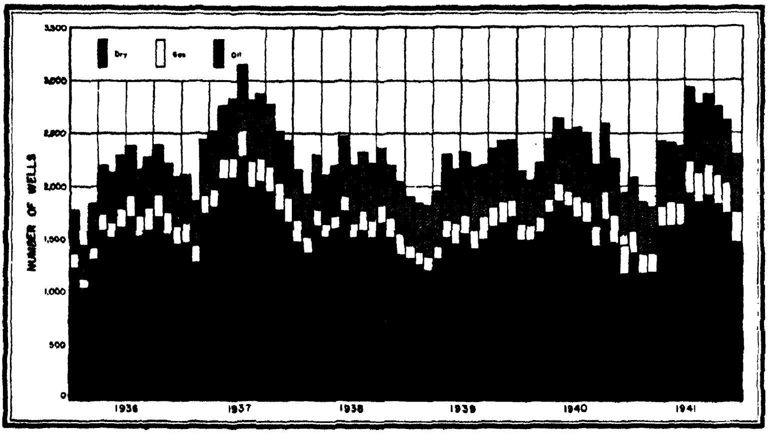

FIGURE 4.—Wells drilled in the United States, 1936–41, by months.

Elimination of excessive drilling was designed by General Preference Order M–68, issued by the Office of the Petroleum Coordinator in December, providing for easy acquisition of drilling and operating material and supplies by operators who conform to that office's spacing pattern—one well to each 40 acres. Further search for oil was encouraged by excluding wells drilled for exploratory operations from any restrictions. As this order was issued near the end of the year, it had no influence on 1941 completions, but it is expected to curtail drilling operations severely in 1942.

Wells drilled for oil and gas in the United States, 1940–41, by months [1]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total: Number	Total: Percent
1940														
Oil	1,489	1,489	1,566	1,749	1,872	1,817	1,709	1,654	1,453	1,689	1,460	1,178	19,125	68.1
Gas	166	149	145	145	166	162	203	210	196	265	268	277	[2] 2,352	8.4
Dry	482	417	508	547	612	574	646	636	552	618	533	492	6,617	23.5
	2,137	2,055	2,219	2,441	2,650	2,553	2,558	2,500	2,201	2,572	2,261	1,947	[2] 28,094	100.0
1941														
Oil	1,368	1,150	1,184	1,612	1,615	1,599	1,934	1,829	1,913	1,821	1,723	1,447	19,195	66.0
Gas	211	198	182	202	236	220	296	288	272	285	308	292	2,990	10.3
Dry	506	487	434	603	554	533	687	647	660	644	584	546	6,885	23.7
	2,085	1,835	1,800	2,417	2,405	2,352	2,917	2,764	2,845	2,750	2,615	2,285	29,070	100.0

[1] Oil and Gas Journal east of California; American Petroleum Institute in California.
[2] Total by months d es not agree with total by States published elsewhere, as latter has been revised upon basis of annual data from State officials.

Wells drilled in the United States and estimated average daily initial oil production per well,[1] 1940–41, by States and districts[2]

State and district	1940					1941			
	Oil		Gas	Dry	Total	Oil	Gas	Dry	Total
	Number	Average initial (barrels)							
Arkansas	114	881	13	60	187	95	20	83	198
California [3]	859	891	15	156	1,030	920	19	179	1,118
Colorado	10	130	1	8	19	16	4	13	33
Illinois	3,049	620	15	750	3,814	2,730	12	890	3,632
Indiana	231	139	77	220	528	262	48	203	513
Kansas	1,410	460	130	342	1,882	1,420	76	517	2,013
Kentucky	224	61	128	231	583	233	275	198	706
Louisiana:									
Gulf Coast	741	307	17	236	994	614	18	240	872
Northern	448	114	82	143	673	467	93	231	791
Total Louisiana	1,189	234	99	379	1,667	1,081	111	471	1,663
Michigan	536	215	59	518	1,113	433	86	419	938
Mississippi	107	554	1	102	210	219	4	59	282
Montana	155	113	49	38	242	160	70	53	283
Nebraska	(4)	(4)	----	(4)	(4)	38	----	51	89
New Mexico	479	345	19	113	611	209	15	53	277
Oklahoma	1,011	204	176	657	1,844	1,099	140	582	1,821
Pennsylvania, New York, Ohio, and West Virginia	2,963	5	1,271	744	4,978	2,895	1,804	771	5,470
Texas:									
Gulf Coast	1,072	276	37	258	1,367	1,353	72	387	1,812
East Texas proper	291	1,035	5	14	310	428	----	14	442
West Texas	1,717	891	11	121	1,849	2,123	13	163	2,299
Rest of State	3,552	308	236	1,780	5,568	3,358	210	1,712	5,280
Total Texas	6,632	486	289	2,173	9,094	7,262	295	2,276	9,833
Wyoming	124	727	8	47	179	123	6	33	162
Other States	32	396	32	79	143	----	5	34	39
Total United States	19,125	396	[5] 2,382	6,617	[5] 28,124	19,195	2,990	6,885	29,070

[1] Not available for 1941.
[2] Oil and Gas Journal, except California.
[3] American Petroleum Institute.
[4] Included in "Other States."
[5] Total by States does not agree with total by months published elsewhere in the Yearbook, as former has been revised upon basis of annual data from State officials

Producing oil wells in the United States and average production per day in 1940, by States and districts[1]

State and district	Producing oil wells		State and district	Producing oil wells	
	Approximate number, Dec 31	Average production per well per day (barrels)		Approximate number, Dec. 31	Average production per well per day (barrels)
Arkansas	2,900	24.0	New York	20,500	0.7
California [2]	15,060	41 2	Ohio	25,200	.3
Colorado	190	22.8	Oklahoma	53,400	7.9
Illinois	20,500	21.0	Pennsylvania	82,100	.6
Indiana	1,650	9 0	Texas:		
Kansas	22,100	8 3	Gulf Coast	11,700	29.8
Kentucky	14,200	1.0	East Texas proper	26,300	14.7
Louisiana:			West Texas	12,300	20.0
Gulf Coast	2,550	96 8	Rest of State	44,900	9.1
Northern	3,550	19.2			
			Total Texas	95,200	14.5
Total Louisiana	6,100	49 7	West Virginia	18,100	.5
Michigan	2,930	19 2	Wyoming	3,500	20.4
Mississippi	115	193.9	Other States [3]	145	6.9
Montana	1,800	10 4			
New Mexico	3,320	34.3	Total wells	389,010	9.6

[1] Figures for 1941 not yet available
[2] American Petroleum Institute.
[3] Missouri, Nebraska, Tennessee, and Utah.

STOCKS

Total crude-oil stocks declined about 19 million barrels in 1941 compared with an increase of over 23 million barrels in 1940. An increase of about 2 million barrels in the first quarter was followed by declines of over 8 million barrels in the second quarter and a further decline of 13 million barrels in the third quarter. These decreases were incident to a more rapid increase than had been anticipated in the demand for all oils. By the fourth quarter, production had been increased to a peak level, and crude stocks showed a slight increase. Total stocks of crude oil amounted to 257,063,000 barrels on December 31, 1941, compared with 275,985,000 barrels on December 31, 1940. Stocks of refinable grades declined by over 17 million barrels, and stocks of California heavy crude decreased less than 2 million.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1937–41

[Thousands of barrels]

Product	1937	1938	1939	1940	1941 [1]
Crude petroleum (refinable):					
At refineries	51,041	51,551	49,215	52,448	51,319
Pipe line and tank farm	243,552	211,931 [2] 211,138	178,810	200,726	183,992
Producers	11,240	11,476	11,953	11,535 [2] 10,905	11,573
Total refinable	305,833	274,958 [2] 274,165	239,978	264,709 [2] 264,079	246,884
California heavy crude	14,505	16,467	13,330	11,906	10,179
Total crude petroleum	320,338	291,425 [2] 290,632	253,308	276,615 [2] 275,985	257,063
Natural gasoline	4,758	4,830	4,421	5,704	4,275
Refined products [3]	239,901	259,665 [2] 272,241	268,109	282,265 [2] 280,958	290,375
Grand total	564,997	555,920 [2] 567,703	525,838	564,584 [2] 562,647	551,713

[1] Subject to revision
[2] For comparison with succeeding year.
[3] Includes also equivalents for wax, coke, and asphalt in barrels

The data on stocks of crude oil by States of origin for 1941 show that the largest declines were 11.7 million barrels for Oklahoma, 2.0 million for California crude of all grades, 1.9 million for Illinois, 1.6 million for Texas, 1.0 million for Kansas, and 0.9 million for Arkansas. Stocks of Appalachian crude decreased 0.7 million barrels and stocks of foreign crude about 0.6 million. The largest increases in crude stocks were 1.7 million barrels for Mississippi, 0.7 million for Michigan, and 0.4 million for Montana.

The demand for domestic crude was almost 7 percent greater in 1941 than in 1940, whereas crude production increased less than 4 percent. This differential is accounted for by the addition to production of 18.3 million barrels taken from all stocks of domestic origin in computing demand for 1941, whereas 22.9 million barrels of the 1940 production went into storage.

Stocks of refinable crude petroleum in the United States in 1941, by States of location and origin and by months [1]

[Thousands of barrels]

State	Jan 1	Jan 31	Feb 28	Mar. 31	Apr 31	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas	2,197	2 120	1 899	1 818	1 676	1,684	1,589	1,696	1,895	1,897	2,007	1,961	1,988
California [2] [3]	35 695	35,837	36,876	37,395	37,172	36,151	34,909	35,614	34,527	34,849	34,835	35,077	35,591
Illinois [4]	13 944	14,266	14,557	14,221	14,475	13,606	13,402	14,066	14,356	13,068	13,019	12,198	12,748
Indiana	3 393	3,480	2,973	3,067	3,184	2,830	3,063	3,219	2,930	3,336	3,271	3,097	3,007
Kansas and Nebraska	10,612	9,950	9,974	9,817	9,982	9,422	9,326	9,249	9,454	9,764	9,612	8,907	9,063
Louisiana, Alabama, and Mississippi	11,497	11,145	10,438	10,707	10,877	11,190	11,781	11,746	11,223	11,032	10,238	10,827	11,739
Maryland [5]	2,474	2,517	2,104	2,459	2,835	1,916	2,418	2,571	2,850	2,399	2,580	2,313	2,149
Michigan and Kentucky	2,873	2,580	2,654	2,639	2,692	2,897	2,818	2,646	2,957	3,121	3,236	3,504	3,890
Missouri [6]	3,831	3,980	4,015	4,013	4,053	3,973	3,684	3,795	3,995	4,143	4,114	4,679	4,377
Montana and Colorado	1,688	1,701	1,734	1,817	1,864	1,992	2,093	2,008	1,988	1,911	2,061	2,164	2,170
New Jersey	6,735	5,463	5,565	4,713	5,699	6,018	6,223	6,925	6,964	6,800	6,180	6,046	5,366
New Mexico	1,229	1,325	1,189	1,252	1,280	1,274	1,335	1,281	1,231	1,160	1,135	1,265	1,209
New York	1,111	1,304	1,218	1,317	1,262	1,217	1,193	1,168	1,282	1,285	1,110	1,142	1,153
Ohio	9,518	9,545	9,903	10,257	10,234	9,711	8,793	8,441	8,344	8,593	7,713	7,673	8,548
Oklahoma	481,838	49,749	49,927	49,736	48,804	47,236	45,295	42,239	41,168	40,633	39,850	39,077	38,768
Pennsylvania	6,586	7,145	6,693	5,881	6,197	6,898	6,922	7,084	6,521	6,660	6,709	6,647	6,379
Texas	86,689	86,092	87,561	90,207	88,671	88,630	88 964	86,469	82,732	80,869	81,601	82,549	84,051
West Virginia	1,927	1,953	1,955	1,939	1,943	1,876	1,824	1,719	1,702	1,511	1,468	1,351	1,371
Wyoming [7]	13,242	13,099	13,207	13,125	13,112	13,590	13,443	13,442	13,501	13,080	12,996	13,202	13,317
Total United States	264,079	263,251	264,432	266,380	266,012	262,111	259,075	255,378	249,620	246,111	243,735	243,679	246,884
ORIGIN													
Arkansas	3,629	3,439	3,172	2,881	2,836	2,680	2,479	2,379	2,586	2,545	2,579	2,516	2,750
California [3]	25,852	35,961	36,985	37,451	37,272	36,221	34,961	35,651	34,560	34,875	34,852	35,082	35,596
Illinois and Indiana	20,790	21,001	21,042	21,167	21,921	20,719	19,577	18,864	19,284	18,938	18,447	17,707	18,413
Kansas and Nebraska	8 654	9,054	9,177	9,124	9,277	8,377	8,300	7,603	7,657	7,689	7,144	7,140	7,704
Louisiana and Mississippi	14,235	14,262	13,249	13,629	14,199	14,111	14,968	15,521	14,878	14,238	14,054	14,718	15,318
Michigan and Kentucky	2,115	1,902	1,990	2,084	2,059	2,175	2,009	1,741	1,907	2,149	2,491	2,642	2,943
Montana and Colorado	1,385	1,379	1,416	1,472	1,496	1,581	1,647	1,579	1,595	1,471	1,690	1,823	1,865
New Mexico	7,570	7,252	7,559	7,357	7,448	7,205	7,506	7,504	7,069	6,915	6,654	6,717	7,078
Ohio	665	647	595	630	620	631	635	653	627	622	696	635	509
Oklahoma	63,574	64,197	63,715	63,351	61,687	60,128	57,700	56,022	54,314	53,928	53,067	52,438	51,919
Pennsylvania, New York, and West Virginia	4,157	4,173	4,154	4,051	4,078	4,024	4,000	3,871	3,804	3,693	3,642	3,382	3,454
Texas	83,908	83,015	84,253	86,299	86,326	87,079	88,518	86,595	84,359	81,961	81,881	82,224	82,297
Wyoming	14,314	14,106	14,297	14,073	14,090	14,518	14,286	14,300	14,390	14,306	14,077	14,325	14,455
Foreign	3,231	2,863	2,828	2,811	2,703	2,662	2,489	3,095	2,590	2,781	2,461	2,330	2,583
Total United States	264,079	263,251	264,432	266,380	266,012	262,111	259,075	255,378	249,620	246,111	243,735	243,679	246,884
Heavy crude in California	11,906	11,839	11,886	11,776	11,802	11,241	10,711	10,556	10,942	10,321	9,869	10,203	10,179

[1] Subject to revision.
[2] Includes Washington.
[3] Heavy crude stocks in California given below.
[4] Includes Minnesota and Wisconsin.
[5] Includes Massachusetts, Rhode Island, and Virginia.
[6] Includes Iowa.
[7] Includes Idaho, South Dakota, and Utah.

Stocks of refinable crude petroleum [1] *in the United States in 1941, by districts and months* [2]

[Thousands of barrels]

District	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries, by field of origin:													
Appalachian:													
Pennsylvania Grade	514	524	519	440	489	459	419	378	387	368	442	367	439
Other Appalachian (including Kentucky)	342	290	361	386	311	313	298	279	241	345	226	312	348
Lima-Northeastern Indiana-Michigan	418	392	405	382	347	409	379	268	331	391	657	674	680
Illinois-Southwestern Indiana	3,397	3,386	3,117	2,994	3,351	2,671	2,380	2,795	3,206	3,052	3,145	3,008	3,423
Northern Louisiana, Arkansas, and Mississippi	3,588	3,237	3,294	2,661	2,858	2,398	3,327	3,504	3,426	3,136	3,446	3,868	3,893
West Texas and Southeastern New Mexico	4,976	4,977	4,964	4,790	4,444	4,835	5,203	4,483	4,453	4,116	4,045	4,957	4,892
East Texas	3,476	3,837	3,065	3,161	3,625	4,023	5,044	3,723	3,791	3,302	3,834	3,048	3,506
Oklahoma, Kansas, North Texas, etc	11,364	11,471	11,951	11,975	11,711	11,146	11,787	12,505	11,945	11,668	11,354	11,060	10,816
Gulf Coast	10,309	9,778	9,814	10,172	10,866	10,596	10,126	11,520	11,266	10,895	10,632	10,697	10,344
Rocky Mountain	2,152	2,005	1,942	1,877	1,823	2,083	2,074	1,922	1,847	1,921	2,204	2,225	2,230
California	8,681	8,618	9,097	8,730	8,285	8,351	8,054	9,159	9,288	9,213	8,645	9,085	8,165
Foreign	3,231	2,863	2,828	2,811	2,703	2,662	2,489	3,095	2,590	2,781	2,461	2,330	2,583
Total at refineries	52,448	51,378	51,357	50,379	50,813	49,946	51,580	53,631	52,771	51,188	51,091	51,631	51,319
Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania Grade	3,520	3,487	3,463	3,444	3,411	3,404	3,420	3,342	3,249	3,175	3,083	2,900	2,880
Other Appalachian (including Kentucky)	1,024	916	879	975	1,013	1,072	1,023	984	1,049	1,026	1,102	1,126	1,124
Lima-Northeastern Indiana-Michigan	604	588	592	613	666	658	595	499	561	639	774	725	875
Illinois-Southwestern Indiana	16,958	17,180	17,485	17,678	18,105	17,563	16,707	15,564	15,568	15,366	14,772	14,154	14,405
Northern Louisiana and Arkansas	5,063	5,035	4,926	4,865	4,976	5,322	5,013	4,989	4,813	4,702	4,388	4,446	4,968
West Texas and Southeastern New Mexico	19,672	18,067	17,710	17,759	18,166	17,317	17,920	18,522	18,172	18,507	19,272	19,232	19,602
East Texas	14,374	14,431	16,019	17,006	17,401	17,478	16,641	16,884	16,213	15,708	15,978	16,510	16,791
Oklahoma, Kansas, North Texas, etc	84,823	85,487	83,977	83,410	81,579	79,646	75,533	72,119	68,965	67,540	65,682	64,992	65,002
Gulf Coast	18,097	18,901	19,382	20,670	19,915	20,705	22,624	21,204	21,476	21,442	20,400	20,497	20,958
Rocky Mountain	13,129	13,053	13,353	13,250	13,360	13,595	13,452	13,553	13,676	13,401	13,151	13,474	13,664
California	23,462	23,698	24,332	25,170	25,482	24,407	23,478	22,898	21,648	22,031	22,632	21,995	23,723
Total pipe line and tank farm	200,726	200,843	202,118	204,840	204,074	201,167	196,406	190,558	185,390	183,537	181,234	180,051	183,992
Producers' stocks	10,905	11,030	10,957	11,161	11,125	10,998	11,089	11,189	11,459	11,386	11,410	11,997	11,573
Total United States:													
1941	264,079	263,251	264,432	266,380	266,012	262,111	259,075	255,378	249,620	246,111	243,735	243,679	246,884
1940 [3]	239,978	240,605	245,210	251,897	258,836	262,593	262,654	264,171	264,913	263,764	264,501	263,803	264,709 [4] 264,079

[1] Excludes stocks of California heavy crude.
[2] Subject to revision.
[3] Revised figures for 1940 (Minerals Yearbook, Review of 1940, p. 962) are as follows (thousands of barrels): Producers' stocks—January 31, 12,310; February 28, 12,034; March 31, 12,290; April 30, 12,207; May 31, 12,105; June 30, 12,290; July 31, 11,886; August 31, 12,128; September 30, 11,903; October 31, 11,819; November 30, 11,778; December 31, 11,535.
[4] For comparison with succeeding year.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Crude runs to stills again exceeded all previous records in 1941, with a total of 1,409 million barrels—an increase of 115 million (8.9 percent) over 1940. Foreign crude runs gained 9 million barrels, and domestic crude runs increased 106 million.

Refinery operations exceeded demand, as indicated by an increase of about 9 million barrels in stocks of refined oils. As there was a further decline in the total exports of refined oils and an increase in the imports of refined products, the gain in total demand for refined products was due entirely to an increase in domestic demand.

There were substantial increases in refinery operations in all districts in 1941. Crude runs increased about 25 million barrels over 1940 in both the Indiana-Illinois-Kentucky and the Texas Gulf Coast districts. East Coast runs were about 13 million barrels greater, and the Oklahoma-Kansas-Missouri and the California districts each showed a gain of over 12 million. Runs in the Louisiana Gulf Coast district rose 9 million barrels. Increases of about 5 million barrels occurred in the Appalachian district and in the Texas Inland and Arkansas-Louisiana Inland districts, and the Rocky Mountain district gained over 3 million barrels.

Distribution.—Receipts of domestic and foreign crude petroleum at refineries in the United States totaled 1,299 million barrels in 1940 and 1,410 million in 1941. In 1941 receipts of foreign crude at refineries were about 51 million barrels or about 3.6 percent of the total compared with 3.3 percent in 1940; interstate receipts of domestic crude were 544 million barrels or 38.6 percent compared with 37.5 percent in 1940; and intrastate receipts were 815 million barrels or 57.8 percent compared with 59.2 percent in 1940.

Refinery receipts of crude in 1941, by methods of transportation, indicated that 73.9 percent of the total was delivered by pipe lines compared with 72.4 percent in 1940; that 22.7 percent was delivered by boat compared with 24.7 percent in 1940; and that 3.4 percent was delivered by tank car and truck compared with 2.9 percent in 1940.

The total demand for domestic crude petroleum in 1941 amounted to 1,422.5 million barrels—a gain of about 92 million (almost 7 percent) over 1940. Domestic crude run to stills was 1,358 million barrels, and the remainder (about 64 million) represented exports, crude used for fuel, and losses.

The most important changes in market demand by States of origin (computed from production and changes in crude stocks by origin) in 1941 compared with 1940 were increases of about 29 million barrels for Texas, 20 million for Kansas, 15 million for Louisiana, 13 million for Oklahoma, 10 million for Mississippi, and 7 million for California. The largest declines in crude demand were about 9 million barrels for Illinois and 5 million for Michigan.

The total demand for Texas crude rose from about 480 million barrels in 1940 to 509 million in 1941—an increase of about 6 percent. In 1941 about 344 million barrels of Texas crude were delivered to refineries within the State and 146 million barrels to refineries in other States; 108 million went to the East Coast district, 23 million to the Indiana-Illinois-Kentucky district, 11 million to refineries in Louisiana, and 3 million to the Oklahoma-Kansas-Missouri district. In addition

Runs to stills of crude petroleum in the United States in 1941, by districts and months [1]

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	13,717	12,750	14,483	13,321	14,183	12,882	13,998	14,640	14,136	15,431	14,837	15,491	169,869
Foreign	2,927	3,003	3,367	3,491	3,791	4,073	4,437	4,435	4,134	4,716	4,544	4,259	47,177
Total East Coast	16,644	15,753	17,850	16,812	17,974	16,955	18,435	19,075	18,270	20,147	19,381	19,750	217,046
Appalachian	4,441	3,903	4,347	4,312	4,430	4,491	4,801	4,490	4,650	4,575	4,484	4,575	53,499
Indiana, Illinois, Kentucky, etc.	19,045	17,884	19,763	18,907	21,883	21,225	22,079	21,759	22,076	22,764	21,794	22,078	251,257
Oklahoma, Kansas, Missouri, etc.	9,786	9,148	10,214	9,950	10,649	10,831	11,296	11,321	11,116	11,411	10,697	10,711	127,130
Texas Inland	5,105	5,047	5,290	5,474	5,635	5,551	5,671	5,910	5,742	5,948	5,506	5,761	66,640
Texas Gulf Coast:													
Domestic	29,022	25,555	27,702	28,558	30,550	28,174	30,376	31,421	30,883	32,000	31,881	33,674	359,796
Foreign	218	350	462	386	89	308	267	300	309	236	286	245	3,456
Total Texas Gulf Coast	29,240	25,905	28,164	28,944	30,639	28,482	30,643	31,721	31,192	32,236	32,167	33,919	363,252
Louisiana Gulf Coast:													
Domestic	4,156	3,741	3,990	3,964	4,472	4,394	4,934	4,899	4,861	4,849	4,822	4,905	53,987
Foreign	2	34	10	42		54		72	44	28	7	20	313
Total Louisiana Gulf Coast	4,158	3,775	4,000	4,006	4,472	4,448	4,934	4,971	4,905	4,877	4,829	4,925	54,300
Arkansas-Louisiana Inland	2,262	2,049	2,267	2,350	2,472	2,124	2,661	2,670	2,694	2,726	2,477	2,613	29,365
Rocky Mountain	2,702	2,244	2,579	2,748	2,608	2,924	3,138	2,936	3,273	2,926	2,644	2,848	33,570
California	17,300	14,737	16,585	17,603	18,673	18,904	17,522	19,719	17,563	19,162	17,560	17,805	213,133
Total domestic	107,536	97,058	107,220	107,187	115,555	111,500	116,476	119,765	116,994	121,792	116,702	120,461	1,358,246
Total foreign	3,147	3,387	3,839	3,919	3,880	4,435	4,704	4,807	4,487	4,980	4,837	4,524	50,946
Total United States	110,683	100,445	111,059	111,106	119,435	115,935	121,180	124,572	121,481	126,772	121,539	124,985	1,409,192
Daily average	3,570	3,587	3,583	3,704	3,853	3,865	3,909	4,018	4,049	4,089	4,051	4,032	3,861

[1] Subject to revision.

to crude, a large volume of products from Texas refineries is shipped to East Coast markets, so that any interruption in tanker transport seriously affects the market demand for Texas crude.

The demand for California crude increased from 225 million barrels in 1940 to 232 million in 1941—about 3.2 percent. The increase in Pacific coast demand for California oil offset the effects of the termination of exports to Japan in August and the elimination of shipments to the East coast. The production of crude was about 230 million barrels, and this was supplemented by a decline of about 2 million barrels in crude stocks. Only about 0.1 million barrels of crude were sent to the East coast in 1941. Practically all of the crude output was refined in the State, except for relatively small exports to Japan and western Canada.

Demand for crude petroleum by States of origin, 1938–41

[Thousands of barrels]

State	1938		1939		1940		1941 [1]	
	Total	Daily ave.	Total	Daily ave.	Total	Daily ave.	Total	Daily ave.
Arkansas	18, 797	51. 5	21, 491	58 7	24, 992	68. 5	27, 206	74. 5
California	240, 053	657. 7	228, 413	624. 1	224, 931	616. 3	232, 246	636. 3
Colorado	1, 484	4. 1	1, 427	3. 9	1, 659	4. 5	1, 775	4. 9
Illinois	22, 589	61. 9	89, 023	243. 2	144, 658	396. 3	136, 057	372. 8
Indiana	991	2 7	1, 596	4. 4	4, 559	12. 5	7, 092	19. 4
Kansas	59, 681	163 5	60, 733	165 9	64, 322	176. 2	84, 228	230. 8
Kentucky	5, 648	15. 5	5, 586	15. 3	5, 075	13. 9	4, 677	12. 8
Louisiana	94, 355	258. 5	96, 650	264. 1	101, 185	277. 2	116, 520	319. 2
Michigan	18, 579	50. 9	23, 363	63. 8	20, 252	55. 5	15, 618	42. 8
Mississippi			73	. 2	3, 490	9. 6	13, 619	37. 3
Montana	4, 894	13 4	6, 227	17 0	6, 964	19. 1	7, 146	19. 6
Nebraska			2		270	. 7	1, 619	4. 4
New Mexico	38, 579	105 7	38, 954	106. 4	37. 600	103. 0	39, 861	109. 2
New York	4, 988	13. 7	5, 352	14. 6	4, 908	13 4	5, 294	14. 5
Ohio	3, 435	9. 4	3, 242	8. 9	3, 164	8. 7	3, 496	9. 6
Oklahoma	195, 434	535. 4	169, 493	463. 1	153, 083	419, 4	166, 414	455. 9
Pennsylvania	17, 183	47. 1	17, 834	48. 7	17, 481	47. 9	16, 771	45. 9
Texas	490, 056	1, 342. 6	503, 770	1, 376. 4	480, 454	1, 316. 3	509, 195	1, 395. 0
West Virginia	3, 410	9. 3	3, 821	10. 4	3, 680	10. 1	4, 006	11 0
Wyoming	23, 056	63 2	24, 436	66. 8	27, 525	75. 4	29. 553	81. 0
Other States	82	. 2	94	. 3	71	. 2	63	2
Total United States	1, 243, 294	3, 406. 3	1, 301, 580	3, 556. 2	1, 330, 323	3, 644. 7	1, 422, 456	3, 897. 1

[1] Subject to revision.

The market demand for Oklahoma crude increased from 153 million barrels in 1940 to 166 million in 1941. In 1941 the production of 155 million barrels was supplemented by withdrawal of over 11 million barrels from stocks. Production has been declining steadily since 1937. Deliveries to refineries within the State amounted to 56 million barrels in 1941. About 16 million barrels were delivered to refineries in Kansas and Missouri, 69 million barrels to Indiana-Illinois-Kentucky refineries, and 14 million to East coast refineries.

The rapid rise in the demand for Illinois crude—from 23 million barrels in 1938 to a peak of almost 145 million in 1940—and then a drop to 136 million in 1941 has materially changed the trends in demand for other States. It has supplied much of the increased crude required in the refineries of the Indiana-Illinois-Kentucky district. Output exceeded demand from 1938 to 1940, resulting in an increase of about 10 million barrels in stocks by States of origin. In 1941, the production of about 134 million barrels was supplemented by a stock

Daily average demand for crude petroleum by States of origin, in 1941,[1] by months

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
Arkansas	75.7	79.2	80.0	73.0	77.2	78.8	75.9	68.0	75.6	70.5	74.2	66.8	74.5
California	607.7	574.5	598.3	619.2	675.2	698.6	621.6	665.1	657.0	666.5	631.8	616.1	636.3
Colorado	4.8	4.8	3.6	5.7	2.4	4.7	6.6	6.5	6.4	4.2	3.6	5.1	4.9
Illinois	321.3	320.5	330.2	316.9	375.1	388.7	376.4	371.4	432.1	437.0	427.7	373.4	372.8
Indiana	23.8	22.5	19.0	19.6	20.0	13.9	15.1	23.0	20.2	18.8	17.2	20.3	19.4
Kansas	184.2	194.8	203.8	202.9	239.3	232.8	263.9	242.8	244.8	269.4	248.7	238.5	230.8
Kentucky	19.0	11.3	10.6	14.5	11.9	15.4	15.9	11.7	10.7	15.0	9.5	8.2	12.8
Louisiana	287.5	326.3	295.8	301.1	327.5	308.5	303.5	336.3	334.6	343.6	328.5	338.1	319.2
Michigan	41.9	37.6	38.1	38.0	34.1	41.9	46.0	37.6	45.9	46.3	54.2	51.5	42.8
Mississippi	18.4	27.7	14.2	11.9	18.9	14.7	39.8	53.4	63.0	56.3	68.2	60.5	37.3
Montana	18.3	17.5	17.5	18.3	19.5	18.8	21.7	19.7	25.3	16.8	20.0	21.6	19.6
Nebraska	2.6	3.6	3.0	3.2	4.2	4.5	5.2	5.5	6.1	5.3	4.8	5.1	4.4
New Mexico	111.4	91.5	111.8	104.3	116.5	99.0	106.8	121.8	114.6	119.5	110.7	100.6	109.2
New York	13.7	13.7	14.0	14.7	14.4	14.5	17.3	12.4	15.7	15.1	14.3	14.1	14.5
Ohio	9.1	10.6	7.2	9.7	8.8	9.3	8.6	9.5	9.7	7.3	11.2	14.0	9.6
Oklahoma	396.8	440.4	432.4	473.0	465.9	502.6	488.2	484.4	449.6	447.2	446.2	444.4	455.9
Pennsylvania	45.6	44.3	44.8	46.4	44.2	42.8	45.3	47.1	46.8	48.1	50.3	45.6	45.9
Texas	1,308.6	1,254.0	1,262.5	1,348.8	1,376.0	1,355.7	1,405.8	1,465.1	1,467.1	1,461.7	1,494.4	1,529.9	1,396.0
West Virginia	8.7	8.7	9.7	8.7	11.9	11.8	11.6	10.3	13.6	11.9	12.5	12.0	11.0
Wyoming	86.9	70.9	82.7	80.4	72.8	90.1	83.0	79.8	86.6	89.4	70.0	78.0	81.0
Other States [2]	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
Total United States	3,586.2	3,554.6	3,579.4	3,710.5	3,916.0	3,947.3	3,958.4	4,071.6	4,125.6	4,150.1	4,098.2	4,044.0	3,897.1

[1] Subject to revision.

[2] Missouri and Tennessee.

decrease of almost 2 million. Production reached a peak of 423,000 barrels daily in October 1941 and declined to about 292,000 barrels daily by May 1942. In 1941, intrastate deliveries of Illinois crude amounted to about 41 million barrels and represented almost half the crude refined in the State. Deliveries to refineries in other States totaled about 80 million barrels, of which 46 million went to other States included in the Indiana-Illinois-Kentucky refining district, 24 million to the Appalachian district, and 10 million to the East Coast district.

The demand for Louisiana crude has been steadily increasing and rose from 101 million barrels in 1940 to over 116 million in 1941. Deliveries to refineries within the State amounted to 39 million barrels in 1941. The principal outside markets are the Texas Gulf and East Coast refinery districts, which received 47 million and 21 million barrels, respectively, in 1941.

The demand for Kansas crude rose to 84 million barrels in 1941—an increase of 20 million over 1940. Demand was about evenly divided between refineries within the State and shipments to other States. Shipments to refineries in Illinois and Indiana amounted to 32 million barrels in 1941 compared with 20 million in 1940.

The demand for New Mexico crude increased to 40 million barrels in 1941—a gain of 2 million. Less than 2 million barrels are used within the State. Deliveries to other districts in 1941 included 25 million barrels to Texas refineries, 7 million to the East Coast district, and over 5 million to Illinois.

The demand for Wyoming crude increased about 2 million barrels to total over 29 million in 1941. Intrastate deliveries amounted to about 14 million barrels, shipments to other Mountain States were about 9 million, and refineries in Indiana, Illinois, Kansas, and Missouri received over 5 million.

The demand for Arkansas crude amounted to 27 million barrels in 1941, of which 13 million barrels went to local refineries and an equal amount was sent to refineries in Louisiana. With the rapid rise in production, the demand for Mississippi crude increased 10 million barrels in 1941 to total about 14 million barrels. About half was delivered to Louisiana refineries, and the rest went to Illinois, Kentucky, and East Coast States. Declining production reduced the demand for Michigan crude to less than 16 million barrels in 1941, the major part being refined within the State.

Distribution of crude petroleum in the United States in 1941, by States [1]

[Thousands of barrels]

State	Production	Refinery receipts of domestic crude, by origin: Illinois	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Other	Runs to stills	Transfers to fuel
Arkansas	26,327							12,882	12,686	281
California	230,263							213,737	[2] 213,133	9,004
Colorado	1,875				1			3,775	3,661	37
Georgia [3]									2,533	
Illinois	134,138	[4] 41,158	8,165	182	5,633	16,910	9,492	3,899	[4] 85,206	593
Indiana	6,634	2,497	23,930			36,217	11,617	4,913	79,144	10
Kansas [5]	84,897		41,890			11,847	885	2,524	57,651	[5] 288
Kentucky [6]	4,774	7,297						9,322	16,398	45
Louisiana:										
Gulf	90,554			34,332			[7] 7,029	12,716	[7] 54,300	1,042
Inland	25,354			5,009			4,438	7,205	16,679	228
Maryland		60		3,749	267		5,298	881	14,004	
Massachusetts [8]				1,046	301		13,791	246	16,748	
Michigan	16,361	5,070				4,793		16,479	26,013	360
Mississippi	15,314									126
Missouri	47		3,059			4,593	1,121	104	8,824	28
Montana	7,526							9,430	9,237	63
New Jersey		7,323		10,621	3,719	3,633	33,314	5,538	75,103	
New Mexico	39,369				1,517		452	26	1,992	82
New York:										
East		1,073		377		121	6,167		12,591	
West	5,185	7,648	14			600		4,135	12,411	
Ohio:										
East	2,960	15,816						1,463	17,414	
West	380	30,869		4		11,394	1,554	662	44,496	234
Oklahoma	154,759		4,501			56,016	853	10	60,655	666
Pennsylvania:										
East		1,557	629	5,148	3,216	10,117	49,847	300	96,067	
West	16,750	30				2,030	246	16,947	19,255	
Texas:										
Gulf	135,139			46,740	22,156	9,907	280,904	838	363,252	981
Inland	372,445			1	2,919	1,275	62,824		66,640	1,147
Utah	4							4,000	3,838	
West Virginia	3,433	763				961		2,712	4,419	
Wyoming	29,694		1					[9] 14,548	[9] 14,842	267
Total United States	1,404,182	121,161	82,189	107,209	39,729	170,414	489,832	349,292	1,409,192	15,482

[1] Subject to revision.
[2] Includes Washington.
[3] Includes Delaware, South Carolina, and Virginia.
[4] Includes Minnesota and Wisconsin.
[5] Includes East Nebraska.
[6] Includes Tennessee.
[7] Includes Alabama and Mississippi.
[8] Includes Rhode Island.
[9] Includes Idaho, West Nebraska, and South Dakota.

Receipts of crude petroleum at refineries in the United States, 1937–41, by methods of transportation

[Millions of barrels]

Method of transportation	1937	1938	1939	1940	1941 [1]
By boat:					
Intrastate	78.5	74.1	72.7	72.1	69.1
Interstate	201 8	182.8	188.6	205.6	199.9
Foreign	27.5	26.4	33.1	42.6	50.6
Total by boat	307.8	283.3	294.4	320.3	319.6
By pipe lines:					
Intrastate	569.6	600.1	651.3	671.0	728.9
Interstate	276.7	254.3	250.5	268.9	313.1
Total by pipe lines	846.3	854.4	901.8	939.9	1,042.0
By tank car and truck:					
Intrastate	28.2	21 9	29.5	26.1	17.2
Interstate	8.5	7.8	10.9	12.7	31.3
Total by tank car and truck	36.7	29 7	40.4	38.8	48.5
Grand total	1,190 8	1,167.4	1,236.6	1,299.0	1,410.1

[1] Subject to revision.

PRICES AND VALUE

Record demand for products of petroleum started crude-oil prices upward early in the year (see fig. 5). Changes to the latter part of May increased the price of Bradford Pennsylvania Grade crude from \$2.15 a barrel to \$2.55; Oklahoma (36°–36.9°) crude from \$1.02 to \$1.17; Santa Fe Springs, California, (33°–33.9°) crude from \$1.14 to \$1.26, and Kettleman Hills crude from \$1.19 (on March 12) to \$1.29. Toward the end of May the Office of Price Administration and Civilian Supply called a meeting of representatives of the oil industry to request that no changes be made in the prices of petroleum or its products without first consulting that office. Postings of higher prices in the Appalachian district in August and in North Texas in November were rescinded after hearings by the Office of Price Administration and Civilian Supply. The price increase in California on May 23, which was coincident with the last increases in other parts of the country, was also rescinded but after later hearings was permitted to stand. In October crude-oil prices were ordered frozen as of October 1, pending study and further action by the Price Administrator.

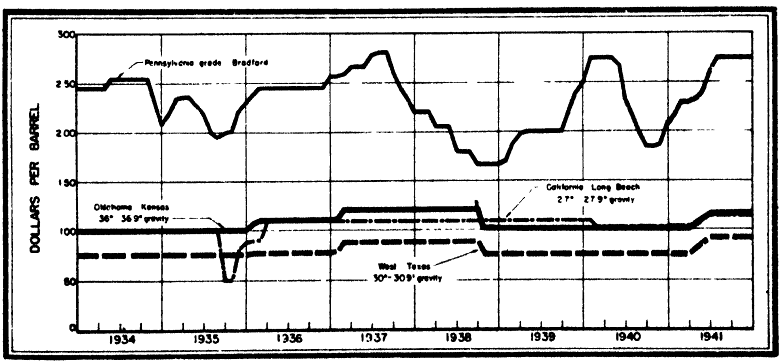

FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States, 1934–41, by months.

Average monthly prices per barrel for selected grades of crude petroleum at wells in the United States in 1941

Month	Pennsylvania Grade: Bradford	Pennsylvania Grade: Southwest Pennsylvania	Illinois Basin	Oklahoma-Kansas 36°–36.9°	Panhandle, Tex. (Carson and Hutchinson Counties, 35°–35.9°)	West Texas, 30°–30.9°	East Texas	Gulf-Coast Grade, 30°–30.9°	California (Long Beach 27°–27.9°)
January	$2.17	$1.82	$1.15	$1.02	$0.81	$0.75	$1.10	$1.08	$1.03
February	2.30	1.95	1.15	1.02	.81	.75	1.10	1.08	1.03
March	2.30	1.95	1.15	1.02	.82	.76	1.10	1.08	1.03
April	2.33	1.98	1.22	1.07	.92	.82	1.15	1.18	1.04
May	2.46	2.10	1.31	1.10	.96	.86	1.19	1.22	1.11
June	2.64	2.29	1.37	1.17	1.02	.92	1.25	1.28	1.15
July	2.75	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
August	2.82	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
September	2.75	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
October	2.75	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
November	2.75	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
December	2.75	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
Average for year	2.57	2.21	1.30	1.12	.96	.86	1.20	1.22	1.11

Posted price per barrel of petroleum at wells in the United States in 1941, by grades, with dates of change

Date	Pennsylvania Grade: Bradford and Allegany districts [1]	Pennsylvania Grade: In Southwest Pennsylvania pipe lines [2]	Corning Grade in Buckeye Pipe Line Co.[2]	Western Kentucky [3]	Illinois Basin [4]	Midland, Mich.[5]	Oklahoma-Kansas [6]: 34°–34.9°	Oklahoma-Kansas [6]: 36°–36.9°
Jan. 1	$2.15	$1.80	$1.12	$1.10	$1.15	$1.12	$0.98	$1.02
Jan. 2			1.22					
Jan. 27	2.30	1.95						
April 1			1.17		1.20	1.27	1.03	1.07
April 7					1.22			
April 23	2.40	2.05	1.17					
April 28				1.22	1.27			
May 1						1.37		
May 2			1.24					
May 20	2.55						1.13	1.17
May 21		2.20		1.32	1.37			
May 27			1.31			1.44		
June 18	2.75	2.40						
Aug. 14	2.98							
Aug. 23	2.75							
	2.57	2.21	1.25	1.24	1.30	1.37	1.08	1.12

Date	Panhandle, Texas (Carson and Hutchinson Counties, 35°–35.9°)[7]	West Texas 30°–30.9° [7]	Lea County, N. Mex. 30°–30.9° [7]	Southwest Texas, Duval-Mirando, 22°–22.9° [8]	East Texas [7]	Gulf Coast: Conroe, Tex.[8]	Gulf Coast: 30°–30.9° [7]	Gulf Coast: 20°–20.9° [7]	Gulf Coast: Tepetate, La.[9]
Jan. 1	$0.81	$0.75	$0.75	$0.92	$1.10	$1.27	$1.08	$0.88	$1.03
Mar. 29	.92	.82	.82	.99	1.15	1.33			
Apr. 1							1.18	.98	1.08
May 21	1.02	.92	.92	1.09	1.25	1.43	1.28	1.08	1.18
	.96	.86	.86	1.03	1.20	1.38	1.22	1.02	1.13

See footnotes at end of table.

Posted price per barrel of petroleum at wells in the United States in 1941, by grades, with dates of change—Continued

Date	Rodessa, La. 36°-36.9°[10]	Smackover, Ark.[10]	Salt Creek, Wyo., 36°-36.9°[11]	Lance Creek, Wyo.[4]	California[12]			
					Kettleman, 38°-38.9°	Long Beach, 27°-27.9°	Midway-Sunset, 19°-19.9°	Santa Fe Springs, 33°-33.9°
Jan. 1	$1.05	$0.73	$1.02	$0.77	$1.33	$1.03	$0.64	$1.14
Mar. 12					1.19		.65	
Apr. 1	1.02	.76		82				
Apr. 24					1.26	1.09	.75	1.26
May 20			1.12	.92				
May 21	1.12	.83						
May 23					1.29	1.15	.81	1.26
July 1				1.12				
	1.09	.80	1.08	.97	1.28	1.11	.89	1.22

1 Tide-Water Associated Oil Co.
2 The South Penn Oil Co.
3 Ashland Refining Co.
4 The Ohio Oil Co.
5 The Pure Oil Co.
6 Standard Oil Co. (Indiana).
7 Humble Oil & Refining Co.
8 The Texas Co.
9 Continental Oil Co.
10 Standard Oil Co. of Louisiana.
11 Stanolind Oil & Gas Co.
12 Standard Oil Co. of California.

Value of crude petroleum at wells in the United States, 1939–40, by States [1]

State	1939		1940	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	16,790	$0 79	21,700	$0.84
California	229,000	1 02	216,720	.97
Colorado	1,330	.95	1,480	.91
Illinois	101,200	1 07	156,500	1.06
Indiana	1,675	98	5,200	1.04
Kansas	63,100	1 04	68,700	1.04
Kentucky	5,900	1 05	5,400	1.04
Louisiana:				
Gulf Coast	72,300	1 06	83,200	1.05
Northern	25,700	1 01	24,300	1.00
Total Louisiana	98,000	1 05	107,500	1.04
Michigan	21,350	.91	20,150	1.02
Mississippi	94	88	3,750	.85
Montana	5,860	98	6,660	.99
New Mexico	30,850	82	32,500	.83
New York	10,650	2 09	11,600	2.32
Ohio	3,600	1 14	4,100	1.30
Oklahoma	166,300	1 04	162,500	1.04
Pennsylvania	36,200	2 08	39,700	2.29
Texas:				
Gulf Coast	132,800	1 08	134,500	1.10
East Texas proper	154,700	1 07	146,900	1 04
West Texas proper	64,400	81	67,600	.80
Rest of State	126,430	92	145,000	1 00
Total Texas	478,330	99	494,000	1.00
West Virginia	6,000	1 68	6,400	1 86
Wyoming	18,150	.85	20,600	.80
Other States [2]	91	.95	280	.81
Total United States	1,294,470	1 02	1,385,440	1.02

1 Figures for 1941 not yet available.
2 Missouri, Nebraska, Tennessee, and Utah

REFINED PRODUCTS

Increase in defense activities during 1941 expanded the requirements from the oil industry so greatly as to tax its refining capacity. In addition to bringing record demands for all products, shifts in importance, although not in quantity, developed, which directed primary interest of the country to the production of aviation gasoline and synthetic rubber.

The future promises an even greater upset in the balance of the products of crude oil. Difficulty in getting tires, along with cessation in the production of new cars, is destined to reduce gasoline consumption to an extent that cannot yet be foreseen. The demand for residual fuel oil for needed war production, however, is increasing. Hence the industry will be presented with the necessity of curtailing the proportion of gasoline produced and at the same time raising the proportion of fuel-oil output in the face of a probability of decreased imports of heavy foreign crude. Greater reforming of gasoline seems necessary to supply at least part of those octane elements lost in the butane, the high octane straight-run naphtha, and the tetraethyl lead being diverted for aviation gasoline. The greater losses in reforming will reduce the yield of gasoline but add to its quality and at the same time supply additional gases for the production of aviation fuel.

Comparative analyses of statistics for the major refined products in the United States, 1937–41

[Thousands of barrels, except as otherwise indicated]

	1937	1938	1939	1940	1941 [1]
Motor fuel:					
Production	571,727	569,162	611,043	616,695	690,958
Imports	144	79	47	97	[2] 596
Exports	38,306	50,109	44,638	25,377	[2] 16,005
Stocks, end of period	74,650	70,779	81,722	83,647	90,688
Domestic demand	519,352	523,003	555,509	589,490	(3)
Kerosine:					
Production	65,308	64,580	68,521	73,882	72,586
Imports				204	[2] 58
Exports	8,886	7,504	8,241	3,374	[2] 1,626
Stocks, end of period	7,083	7,799	7,576	9,512	9,599
Domestic demand	54,972	56,360	60,503	68,776	(3)
Distillate fuel oil:					
Production	146,706	151,774	161,746	183,304	189,177
Transfers [4]	(3)	623	2,741	2,576	2,513
Imports	17			3,333	[2] 3,707
Exports	30,129	29,641	32,020	19,140	[2] 11,400
Stocks, end of period	22,566	27,873 [5] 36,224	33,718	42,940	49,926
Domestic demand	116,841	117,449	[6] 134,973	160,851	(3)
Residual fuel oil:					
Production	312,064	294,890	305,944	316,221	342,367
Transfers [4]	17,423	10,037	9,668	7,699	12,969
Imports	22,114	21,065	15,680	29,366	[2] 23,582
Exports	15,304	17,920	17,485	16,109	[2] 10,796
Stocks, end of period	81,507	97,746 [5] 101,971	92,290	89,304	83,195
Domestic demand	325,514	291,833	[6] 323,488	340,163	(3)
Lubricating oil:					
Production	35,321	30,826	35,036	36,765	39,530
Imports	7	7	5	11	(3)
Exports	10,975	9,417	11,881	10,461	[2] 6,920
Stocks, end of period	7,512	7,695	7,142	8,767	8,127
Domestic demand	23,323	21,233	23,713	24,690	(3)

See footnotes at end of table

Comparative analyses of statistics for the major refined products in the United States, 1937–41—Continued

[Thousands of barrels, except as otherwise indicated]

	1937	1938	1939	1940	1941 [1]
Wax (thousands of pounds):					
Production	521,640	435,400	464,520	513,240	676,480
Imports	86,929	28,927	39,913	83,102	[2] 6,176
Exports	231,723	201,447	232,664	189,794	[2] 132,653
Stocks, end of period	144,992	129,340	75,648	125,272	74,814
Domestic demand	297,288	278,532	325,461	356,924	([3])
Coke (thousands of short tons):					
Production	1,306.6	1,602.2	1,666.4	1,526.6	1,648.8
Exports	164.3	155.6	286.2	298.7	[2] 185.1
Stocks, end of period	378.6	707.5	666.0	487.0	228.0
Domestic demand	1,153.1	1,117.7	1,421.7	1,406.9	([3])
Asphalt (thousands of short tons):					
Production	4,182.0	4,341.4	4,954.2	5,346.7	6,557.6
Imports	34.1	33.2	73.9	137.7	[2] 80.4
Exports	45.5	49.9	42.4	296.4	[2] 187.1
Stocks, end of period	557.4	490.4	550.0	614.0	604.0
Domestic demand	3,977.4	4,391.7	4,926.1	5,124.0	([3])
Road oil:					
Production	8,087	7,543	7,868	7,771	9,149
Stocks, end of period	984	680	702	624	793
Domestic demand	7,954	7,847	7,846	7,849	8,980
Other finished products:					
Production	2,382	1,921	2,359	3,202	3,986
Exports	101	112	123	708	[2] 442
Stocks, end of period	230	263	276	359	384
Domestic demand	2,249	1,776	2,223	2,411	([3])

[1] Subject to revision.
[2] Figures for imports and exports for 1941 cover January to September, inclusive.
[3] Figures not available.
[4] Net transfers from crude oil to fuel oil; California only, 1937–38.
[5] Includes terminal stocks; compares with succeeding years
[6] Upon new basis with transfers east of California included.

Runs to stills and production at refineries in the United States of the various refined products, 1937–41

[Thousands of barrels, except as otherwise indicated]

Product	1937	1938	1939	1940	1941 [1]
Input:					
Crude petroleum:					
Domestic	1,157,444	1,138,828	1,204,350	1,252,364	1,358,246
Foreign	25,996	26,187	33,490	41,798	50,946
Total crude petroleum	1,183,440	1,165,015	1,237,840	1,294,162	1,409,192
Natural gasoline	39,381	39,961	39,606	39,547	47,825
Total input	1,222,821	1,204,976	1,277,446	1,333,709	1,457,017
Output:					
Gasoline	559,141	556,012	596,501	597,375	671,110
Kerosine	65,308	64,580	68,521	73,882	72,586
Distillate fuel oil	146,706	151,774	161,746	183,304	189,177
Residual fuel oil	312,064	294,890	305,944	316,221	342,367
Lubricating oil	35,321	30,826	35,036	36,765	39,539
Wax	1,863	1,555	1,659	1,833	2,416
Coke	6,533	8,011	8,332	7,633	8,244
Asphalt	23,001	23,878	27,248	29,406	36,067
Still gas	64,218	65,890	68,779	75,950	77,254
Wax ... thousands of pounds	521,640	435,400	464,520	513,240	676,480
Coke ... thousands of short tons	1,306.6	1,602.2	1,666.4	1,526.6	1,648.8
Asphalt ... do	4,182.0	4,341.4	4,954.2	5,346.7	6,557.6
Still gas ... millions of cubic feet	241,981	250,382	261,360	273,420	293,565
Road oil	8,087	7,543	7,868	7,771	9,149
Other finished products	2,382	1,921	2,359	3,202	3,986
Crude gasoline (net)	[2] 128	[2] 1,616	[2] 439	902	1,219
Other unfinished oils (net)	[2] 7,931	[2] 4,530	[2] 11,731	[2] 3,848	[2] 3,204
Shortage	6,256	4,242	5,623	3,313	7,107
Total output	1,222,821	1,204,976	1,277,446	1,333,709	1,457,017

[1] Subject to revision.
[2] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced

Noteworthy among developments during 1941 were the controls of the oil industry brought about by the necessities of national defense. Price control was initiated on May 27, beginning with a request—later followed by a number of other requests and orders—by the Office of Price Administration and Civilian Supply that no prices be advanced without prior consultation with that office. Immediately following, on May 31, a Coordinator of Petroleum was appointed, under whose jurisdiction a number of regulations affecting the industry were promulgated. Among these were a request to the motorists in the Atlantic States to reduce their gasoline consumption by one-third, restriction of gasoline deliveries to service stations, and closing of the stations from 7 p. m. to 7 a. m., prohibiting the use of high-octane blending agents in any except aviation gasoline, and requests not to drill unnecessary wells. Exports of petroleum to Japan were prohibited August 1. The Supplies Priority and Allocation Board, organized in September, allocated steel and equipment and controlled drilling and other operations by withholding priorities.

The advent of the heavy gasoline-consuming season raised a transportation problem because the United States Government loaned a large number of tankers to Great Britain, starting with 25 sent in May. The efforts to meet the domestic situation resulting from this loan included increased movement of oil by barge and railroad and attempts to restrict consumption of gasoline for nonessential uses along the East coast. Gasoline prices were raised in this area, deliveries to dealers were cut, and service stations closed 12 hours every day. The proposal to build a pipe line from Texas to the East coast was opposed by numerous interests, and on September 9 the Supply Priorities and Allocation Board refused to allot steel for its construction. A transportation pinch was felt on the Pacific coast also, although not sufficiently to create great difficulties. The return of 25 tankers from Great Britain in the latter part of October, coinciding with the end of the heavy motoring season, solved the problem temporarily, although the Japanese declaration of war on December 7 forecast even greater transportation difficulties for the future.

The domestic demand for motor fuel increased 12 percent in 1941, the same as for residual fuel oil. Distillate fuel oil gained 8 percent, but wax—with an increase of almost 50 percent—had the greatest relative gain. The domestic demand for lubricating oil increased more than 20 percent.

Crude-oil runs to stills in 1941 totaled 1,409 million barrels compared with 1,294 million in 1940—a gain of 115 million barrels (9 percent) Foreign crude runs amounted to 51 million barrels compared with 42 million in 1940.

Refinery output of motor fuel increased 12 percent—from 597 million barrels to 671 million—the latter comprising 279 million barrels of straight-run gasoline, 344 million of cracked gasoline, and 48 million of natural gasoline.

The yield of gasoline, which had dropped from 45.0 percent of the crude oil run to stills in 1939 to 43.1 percent in 1940, recovered to 44.2 percent in 1941 (see fig. 6). Distillate fuel oil, influenced by a mild winter (see gasoline temperature index, under "Motor fuel"), receded from its 1940 record of 14.2 percent to 13.4. Of the other principal products, the yield of kerosine dropped from 5.7 to 4.2 and residual fuel oil from 24.4 to 24.3.

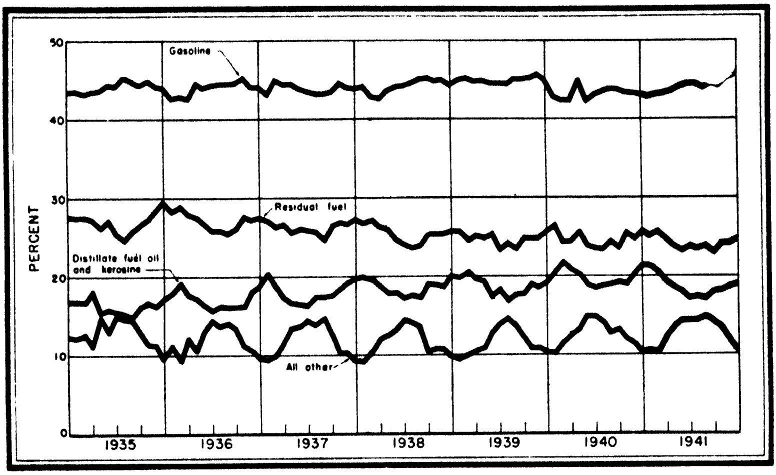

FIGURE 6.—Yields of principal petroleum products from crude oil run to stills in the United States, 1935–41, by months.

Summary of percentage yields of refined products in the United States, 1933–41

[Computed on total crude runs to stills]

Product	1933	1934	1935	1936	1937	1938	1939	1940	1941 [1]
Finished products:									
Gasoline [2]	43.7	43.4	44.2	44.1	43.9	44 3	45.0	43.1	44.2
Kerosine	5.7	6.0	5.8	5.2	5.5	5.5	5 5	5.7	5.2
Distillate fuel oil	9 2	10.6	10.4	11.8	12.4	13.0	13 1	14.2	13.4
Residual fuel oil	27.6	26 8	26 9	27.0	26 4	25.3	24.7	24.4	24.3
Lubricating oil	2.8	2.9	2 9	2.9	3 0	2 6	2.8	2.8	2.8
Wax	2	.2	.2	.2	.2	.1	.1	.1	.2
Coke	.9	.7	.7	.6	.6	.7	.7	.6	.6
Asphalt	1.5	1 8	1.8	2.0	1.9	2.1	2 2	2.3	2.5
Road oil	.6	7	.6	.7	.7	.6	.6	.6	.6
Still gas	5.2	5 0	5 3	5.3	5.4	5 7	5.5	5.5	5.5
Other	.2	.2	.2	.2	.2	.2	.2	.3	.3
Unfinished products:									
Gasoline	} .5	{ [3].3	.1	([4])	([3 4])	[3].1	([3 4])	1	.1
Other		.2	[3].3	[3].8	[3].7	[3].4	[3].9	[3].3	[3].2
Shortage	1.9	1.8	1.2	.8	5	.4	.5	.6	.5
	100.0	100.0	100.0	100.0	100.0	100.0	100 0	100.0	100.0

[1] Subject to revision.
[2] Based upon total gasoline production minus natural gasoline used.
[3] Negative percentage; represents excess percentage rerun over percentage produced.
[4] Less than 0 1 percent.

The crude oil run of 1,409,192,000 barrels, mentioned before, represented an increase of 9 percent over the runs in 1940. These increases were distributed through all of the districts. Those in the Indiana, Illinois, Kentucky, etc., and the Texas Gulf Coast districts—25,410,000 and 25,329,000 barrels, respectively, representing relative increases of 11.3 and 7.5 percent—were greatest; however, the largest relative increases were in the Louisiana Gulf Coast and Inland Louisiana-Arkansas districts, where the gains were 20.4 and 18.5 percent, respectively.

Prices were weak during the first days of the year, and some of them sank below their low point at the close of 1940 (see fig. 7). As the year progressed, however, they gained strength, until the action of the Office of Price Administration and Civilian Supply ("Prices and value")

Stocks of refined products in the United States, 1940–41, by months

[Thousands of barrels, except as otherwise indicated]

Product	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
1940												
Gasoline	84,863	92,721	96,467	96,615	93,474	86,276	82,025	77,134	75,915	73,338	73,429	77,943
Kerosine	4,918	4,302	4,114	4,351	5,309	6,810	8,191	9,476	10,254	11,000	10,473	9,512
Distillate fuel oil	26,462	24,640	23,086	25,092	28,220	33,585	39,412	45,041	48,828	49,037	46,624	[1] 42,940
Residual fuel oil	89,281	89,784	89,351	88,932	89,835	91,148	93,029	94,421	94,947	94,658	92,392	[1] 89,304
Lubricating oil	7,328	7,825	8,084	8,065	8,170	8,161	8,573	8,457	8,596	8,464	8,365	8,767
Wax	266	295	323	346	369	394	407	401	393	407	429	447
Coke	3,140	3,140	3,120	3,315	3,405	3,485	3,390	3,235	3,085	2,905	2,635	2,435
Asphalt	3,262	3,559	3,845	4,224	4,174	3,745	3,427	3,234	2,695	2,579	2,893	3,377
Wax ... thousands of pounds	74,575	82,631	90,373	96,910	103,289	110,346	113,978	112,359	110,028	113,827	120,212	125,272
Coke ... thousands of short tons	628.0	628.0	624.0	663.0	681.0	697.0	678.0	647.0	617.0	581.0	527.0	487.0
Asphalt ... do	593.0	647.0	699.0	768.0	759.0	681.0	623.0	588.0	490.0	469.0	526.0	614.0
Road oil	763	809	924	1,145	1,360	1,257	1,077	892	844	719	570	624
Other finished products	288	320	368	407	405	411	417	379	358	341	352	359
Unfinished gasoline	6,112	6,574	7,243	6,948	7,385	7,293	7,040	6,567	5,992	5,847	6,088	6,466
Other unfinished oils	36,108	36,495	36,920	38,299	40,070	41,340	42,083	41,541	42,188	41,623	41,052	40,091
Total	262,791	270,464	273,845	277,739	282,176	283,905	289,071	290,778	294,095	290,918	285,302	[1] 282,265
1941 [2]												
Gasoline	83,310	88,609	91,501	88,414	85,425	82,411	77,429	73,094	72,761	74,698	79,378	86,413
Kerosine	8,312	7,634	6,724	7,063	8,421	9,609	10,635	11,636	11,662	11,670	10,843	9,599
Distillate fuel oil	37,926	34,790	29,805	31,725	35,389	38,274	43,037	47,163	51,412	55,385	55,073	49,926
Residual fuel oil	85,092	82,902	81,634	79,138	79,218	79,948	80,760	82,268	83,752	84,960	83,730	83,195
Lubricating oil	8,809	8,790	8,637	8,363	7,835	7,353	7,107	7,206	7,415	7,487	7,752	8,127
Wax	429	426	435	415	423	395	362	306	284	270	272	267
Coke	2,030	1,875	1,875	2,000	1,925	1,910	1,835	1,860	1,850	1,810	1,950	1,140
Asphalt	3,790	4,180	4,571	5,132	5,302	4,626	3,922	3,328	2,607	2,481	2,816	3,322
Wax ... thousands of pounds	120,027	119,150	121,887	116,096	118,456	110,481	101,404	85,824	79,458	75,467	76,413	74,814
Coke ... thousands of short tons	406.0	375.0	375.0	400.0	385.0	382.0	367.0	372.0	370.0	362.0	390.0	228.0
Asphalt ... do	689.0	760.0	831.0	933.0	964.0	841.0	713.0	605.0	474.0	457.0	512.0	604.0
Road oil	717	760	892	1,047	1,123	1,150	1,028	812	658	701	690	793
Other finished products	360	365	369	459	378	381	382	385	344	379	426	384
Unfinished gasoline	7,056	6,949	7,205	7,355	7,406	7,347	7,272	7,283	7,202	7,605	7,900	7,685
Other unfinished oils	39,542	39,284	40,227	40,857	41,992	41,825	41,389	42,005	42,464	42,258	40,975	39,524
Total	277,373	276,564	273,875	271,968	274,837	275,229	275,158	277,346	282,411	289,704	291,805	290,375

[1] Stocks upon new basis, which excludes stocks in bond, for January 1, 1941, are as follows: Distillate fuel oil, 42,911; residual fuel oil, 88,026; total stocks, 280,958.
[2] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined products, 1940–41, by months

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1940													
Input													
Crude petroleum	106,530	101,742	110,034	106,927	111,817	108,237	107,902	108,756	107,756	109,394	105,364	109,703	1,294,162
Natural gasoline	3,285	3,091	3,034	2,853	3,095	2,620	2,768	3,092	3,744	4,156	4,026	3,783	39,547
Total input	109,815	104,833	113,068	109,780	114,912	110,857	110,670	111,848	111,500	113,550	109,390	113,486	1,333,709
Output:													
Gasoline	48,985	46,253	49,493	48,784	50,444	49,281	49,684	50,799	51,088	51,726	49,795	51,043	597,375
Kerosine	5,375	5,945	6,570	6,257	6,641	5,785	5,797	5,629	6,062	6,496	6,431	6,894	73,882
Distillate fuel oil	16,548	16,262	16,346	15,260	14,541	14,154	14,439	14,957	14,755	14,381	15,073	16,608	183,304
Residual fuel oil	28,082	24,680	26,870	25,372	26,551	25,469	25,248	26,451	25,504	27,944	26,125	27,925	316,221
Lubricating oil	3,308	3,108	3,335	3,280	3,341	3,212	3,024	2,635	2,682	2,954	3,021	2,865	36,765
Wax	173	177	169	152	158	142	134	119	142	154	157	156	1,833
Coke	582	656	648	696	762	743	607	613	596	657	442	631	7,633
Asphalt	1,139	1,208	1,783	2,200	2,682	2,900	3,336	3,509	3,326	3,346	2,183	1,794	29,406
Still gas	5,872	5,742	6,433	6,293	6,829	6,768	6,636	6,780	6,404	6,234	5,937	6,022	75,950
Wax ..... thousands of pounds	48,440	49,560	47,320	42,560	44,240	39,760	37,520	33,320	39,760	43,120	43,960	43,680	513,240
Coke ..... thousands of short tons	116.4	131.2	129.6	139.2	152.4	148.6	121.4	122.6	119.2	131.4	88.4	126.2	1,526.6
Asphalt ..... do	207.2	219.6	324.2	400.0	487.6	527.3	606.6	638.0	604.7	608.4	396.9	326.2	5,346.7
Still gas ..... millions of cubic feet	21,139	20,671	23,159	22,655	24,584	24,365	23,890	24,408	23,054	22,443	21,373	21,679	273,420
Road oil	193	116	226	411	826	1,172	1,449	1,368	1,080	558	149	223	7,771
Other finished products	292	278	297	280	254	258	293	247	243	225	262	273	3,202
Unfinished gasoline (net)	548	462	669	[1] 295	437	[1] 92	[1] 253	[1] 473	[1] 575	[1] 145	241	378	902
Other unfinished oils (net)	[1] 1,620	[1] 284	[1] 139	645	1,007	583	[1] 32	[1] 1,231	64	[1] 961	[1] 685	[1] 1,195	[1] 3,848
Shortage	338	230	368	445	439	482	308	445	149	[2] 19	259	[2] 131	3,313
Total output	109,815	104,833	113,068	109,780	114,912	110,857	110,670	111,848	111,500	113,550	109,390	113,486	1,333,709
1941 [3]													
Input:													
Crude petroleum [4]	110,683	100,445	111,059	111,106	119,435	115,935	121,180	124,572	121,481	126,772	121,539	124,985	1,409,192
Natural gasoline	3,828	3,312	3,774	3,498	3,399	3,518	3,628	4,130	4,751	4,997	4,518	4,472	47,825
Total input	114,511	103,757	114,833	114,604	122,834	119,453	124,808	128,702	126,232	131,769	126,057	129,457	1,457,017

See footnotes at end of table.

Runs to stills and production at refineries in the United States of the various refined products, 1940–41, by months—Continued

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1941 [3]													
Output:													
Gasoline	51, 173	46, 841	51, 950	52, 009	56, 188	55, 136	57, 714	58, 954	58, 988	61, 037	59, 480	61, 640	671, 110
Kerosine	6, 661	5, 888	6, 033	6, 068	6, 033	5, 218	5, 406	5, 850	5, 949	6, 355	6, 443	6, 682	72, 586
Distillate fuel oil	17, 018	14, 732	15, 387	14, 692	15, 546	14, 697	15, 746	15, 409	16, 024	16 554	16, 230	17, 142	189, 177
Residual fuel oil	27, 880	25, 944	27, 677	26, 748	27, 994	27, 882	28, 624	29, 836	28, 118	30, 871	29, 666	31, 127	342, 367
Lubricating oil	2. 943	2, 522	2, 813	3, 213	3, 322	3, 520	3, 563	3, 561	3, 427	3, 494	3, 607	3, 554	39, 539
Wax	161	139	183	201	205	195	198	194	237	242	246	215	2, 416
Coke	629	513	625	641	700	722	671	685	789	768	747	754	8, 244
Asphalt	1, 667	1, 685	2, 053	2, 689	3, 310	3, 490	3, 779	4, 074	3, 741	3, 819	3, 194	2, 566	36. 067
Still gas	5, 349	4, 960	6, 251	6, 443	7, 059	6, 759	6, 976	6, 991	6, 625	6, 774	6, 410	6, 657	77, 254
Wax ... thousands of pounds	45, 080	38, 920	51, 240	56, 280	57, 400	54, 600	55, 440	54, 320	66, 360	67, 760	68, 880	60, 200	676, 480
Coke ... thousands of short tons	125 8	102 6	125 0	128. 2	140 0	144 4	134 2	137. 0	157 8	153. 6	149 4	150 8	1, 648. 8
Asphalt ... do	303 1	306 4	373 3	488 9	601 8	634 5	687. 1	740 7	680 2	694 4	580. 7	466 5	6, 557 6
Still gas ... millions of cubic feet	20, 326	18, 848	23, 754	24, 483	26, 824	25, 684	26, 509	26, 566	25, 175	25, 741	24, 358	25, 297	293. 565
Road oil	218	107	198	347	846	1, 383	1, 700	1, 478	1, 308	793	428	343	9, 149
Other finished products	282	282	368	351	390	350	356	333	306	345	345	278	3, 986
Unfinished gasoline (net)	590	[1] 107	256	150	51	[1] 59	[1] 75	11	[1] 81	403	295	[1] 215	1, 219
Other unfinished oils (net)	[1] 824	[1] 484	567	372	780	[1] 551	[1] 620	509	336	[1] 306	[1] 1, 407	[1] 1, 576	[1] 3, 204
Shortage	764	735	472	680	410	711	770	817	465	620	373	290	7, 107
Total output	114, 511	103, 757	114, 833	114, 604	122, 834	119, 453	124, 808	128, 702	126, 232	131, 769	126, 057	129, 457	1, 457, 017

[1] Negative quantity; represents net excess rerun over production. [2] Negative quantity (overage). [3] Subject to revision.
[4] Detail by districts and months in section on "Consumption and distribution of crude petroleum."

Runs to stills and production at refineries in the United States of the various refined products, 1940–41, by districts

[Thousands of barrels, except as otherwise indicated]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	United States
1940											
Input											
Crude petroleum	204,469	48,225	225,847	114,847	61,802	337,923	45,082	24,788	30,156	201,023	1,294,162
Natural gasoline	1,791	384	5,685	5,238	6,651	6,350	278	361	732	12,077	39,547
Total input	206,260	48,609	231,532	120,085	68,453	344,273	45,360	25,149	30,888	213,100	1,333,709
Output:											
Gasoline	77,344	23,508	125,405	65,585	40,072	144,813	16,514	10,861	16,388	76,885	597,375
Kerosine	11,447	3,213	10,344	7,196	2,753	26,164	5,897	2,722	824	3,322	73,882
Distillate fuel oil	39,976	4,035	23,943	11,548	2,257	62,029	7,407	1,509	2,182	28,418	183,304
Residual fuel oil	53,252	6,350	37,817	19,787	13,703	78,850	9,887	6,279	6,603	83,693	316,221
Lubricating oil	8,550	6,016	3,545	3,447	238	9,142	1,630	680	179	3,338	36,765
Wax	700	358	195	141	5	273	100		61		1,833
Coke	26	128	4,718	815	384	746			220	596	7,633
Asphalt	9,772	931	5,417	2,219	1,069	1,904	2,006	1,111	814	4,163	29,406
Still gas	10,779	2,800	15,586	6,305	4,217	24,210	2,671	852	1,573	6,957	75,950
Wax .... thousands of pounds	196,000	100,240	54,600	39,480	1,400	76,440	28,000		17,080		513,240
Coke .... thousands of short tons	5.2	25.6	943.6	163.0	76.8	149.2			44.0	119.2	1,526.6
Asphalt .... do	1,777.0	169.3	984.9	403.5	194.5	346.1	364.6	202.0	147.9	756.9	5,346.7
Still gas .... millions of cubic feet	38,804	10,080	56,110	22,698	15,181	87,156	9,616	3,067	5,663	25,045	273,420
Road oil	273	154	2,274	722		216	10	214	1,267	2,641	7,771
Other finished products	1,196	294	850	133	140	283	100		28	178	3,202
Unfinished gasoline (net)	93	90	[1] 380	514	151	[1] 222	[1] 24	[1] 21	21	680	902
Other unfinished oils (net)	[1] 5,395	[1] 261	1,711	[1] 714	1,087	[1] 231	[1] 961	392	[1] 51	575	[1] 3,848
Shortage	[2] 1,753	993	107	2,387	2,377	[2] 3,904	123	550	779	1,654	3,313
Total output	206,260	48,609	231,532	120,085	68,453	344,273	45,360	25,149	30,888	213,100	1,333,709
1941 [3]											
Input:											
Crude petroleum	217,046	53,499	251,257	127,130	66,640	363,252	54,300	29,365	33,570	213,133	1,409,192
Natural gasoline	1,984	483	7,371	4,700	7,782	9,349	779	803	789	13,785	47,825
Total input	219,030	53,982	258,628	131,830	74,422	372,601	55,079	30,168	34,359	226,918	1,457,017

See footnotes at end of table

Runs to stills and production at refineries in the United States of the various refined products, 1940–41, by districts—Continued

[Thousands of barrels, except as otherwise indicated]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	United States
1941 [3]											
Output:											
Gasoline	85,379	25,606	138,481	71,388	44,143	168,204	21,265	13,079	17,831	85,734	671,110
Kerosine	9,169	3,166	11,864	7,505	2,987	24,448	7,304	3,080	906	2,157	72,586
Distillate fuel oil	40,827	4,863	26,288	13,431	2,430	59,591	8,631	2,535	2,778	27,803	189,177
Residual fuel oil	50,113	7,709	46,761	22,408	14,280	84,806	13,070	7,180	7,629	88,411	342,367
Lubricating oil	8,608	6,414	4,307	3,976	358	9,677	2,093	679	187	3,240	39,539
Wax	834	400	176	183	5	438	319		61		2,416
Coke	22	130	4,470	907	597	925			247	946	8,244
Asphalt	11,759	1,419	7,303	2,757	1,342	1,995	2,294	1,566	739	4,893	36,067
Still gas	11,720	2,796	15,649	6,502	4,098	24,501	2,037	924	1,631	7,396	77,254
Wax ... thousands of pounds	233,520	112,000	49,280	51,240	1,400	122,640	89,320		17,080		676,480
Coke ... thousands of short tons	4.4	26.0	894.0	181.4	119.4	185.0			49.4	189.2	1,648.8
Asphalt ... do	2,138.0	258.0	1,327.8	501.3	244.0	362.7	417.1	284.7	134.4	889.6	6,557.6
Still gas ... millions of cubic feet	44,536	10,625	59,467	24,707	15,572	93,104	7,741	3,511	6,198	28,104	293,565
Road oil	366	42	2,477	697		173	3	138	1,651	3,602	9,149
Other finished products	1,574	295	1,213	176	146	126	158	33	56	209	3,986
Unfinished gasoline (net)	212	[1] 173	[1] 30	[1] 88	126	618	99	[1] 14	[1] 12	481	1,219
Other unfinished oils (net)	[1] 181	204	372	[1] 662	1,012	[1] 1,333	[1] 2,695	541	100	[1] 562	[1] 3,204
Shortage	[2] 1,372	1,111	[2] 703	2,650	2,898	[2] 1,568	501	427	555	2,608	7,107
Total output	219,030	53,982	258,628	131,830	74,422	372,601	55,079	30,168	34,359	226,918	1,457,017

[1] Negative quantity; represents net excess rerun over production.
[2] Negative quantity (overage).
[3] Subject to revision.

effectively halted advances in crude-oil prices, although those of refined products continued to rise. Refinery prices for gasoline reached their peak in July, but service-station prices advanced until December. Refinery prices of some lubricating oils reached their peak in the summer and declined thereafter, but others continued to rise until fall or near the end of the year. Most fuel-oil prices reached their peak during the summer or fall, as did also the price of wax. The request in the early part of the year that prices should not be changed became orders in October and November, when crude-oil prices were frozen as of October 1 and refined-oil prices as of November 7.

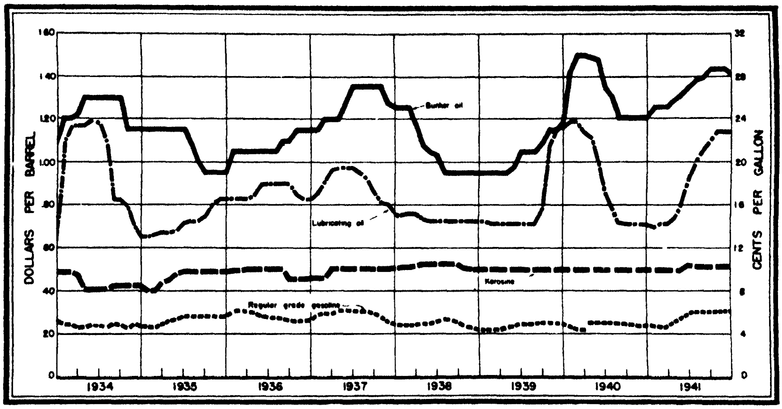

FIGURE 7.—Prices of Bunker "C" fuel oil at New York, bright stock at Oklahoma refineries, tank wagon price of kerosine at Chicago, and regular grade gasoline at refineries in Oklahoma, 1934–41, by months.

REFINERY CAPACITY

A huge program of refinery building was initiated in 1941, but little of it was destined to increase crude-oil capacity, as it was mostly earmarked for the production of such special commodities as butadiene, aviation gasoline, and toluene. Only one new plant of 4,000 barrels crude oil capacity was being built on January 1, 1942, and additional crude oil capacity of 39,400 barrels was under construction at refineries already in existence.

Although the total number of refineries dropped from 562 to 523, their daily capacity rose from 4,860,194 barrels to 4,999,999, due largely to elimination of shut-down plants of small capacity, which declined in number from 136 to 92, and additional capacity completed for existing plants. The number operating increased from 420 to 430 and their daily capacity from 4,180,588 to 4,496,843 barrels. The largest increases in capacity were in the Texas Gulf Coast, California, and Indiana, Illinois, Kentucky, etc., districts, where the gains were 163,000, 157,000, and 149,000 barrels, respectively.

Cracking capacity rose from 1,151,193 barrels of gasoline output daily on January 1, 1941, to 1,222,684 on January 1, 1942. A decline in both the capacity shut-down and that under construction made the operating capacity 1,144,594 barrels compared with 1,021,006 on January 1, 1941.

Emphasis in refinery construction during 1941 centered on aviation gasoline refineries, but interest in synthetic rubber plants developed at the end of the year. The former include catalytic cracking plants,

polymerization plants, alkylation plants, isobutane and isopentane plants, and aviation-base stocks plants.

Production of high-octane blending agents by the alkylation method is rapidly supplanting the method of polymerizing butane to iso-octene followed by hydrogenation of the codimer obtained. The principal reason for this is that the alkylation method involves both a lower investment and lower operating costs. In addition to the thermal alkylation and the low-temperature sulfuric acid catalytic methods of alkylation described in a previous Minerals Yearbook, a patent was granted late in 1941 covering an alkylation method using hydrofluoric acid as a catalyst. One of the principal advantages claimed for this method is the ability to use propane as well as butane for a charging stock in addition to the advantage of being able to operate at normal temperatures, thus eliminating the need for refrigeration.

One plant to be completed early in 1942 will produce a new aviation-gasoline blending agent—cumene or isopropyl benzene.

Summary of refinery capacity in the United States, January 1, 1938–42

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
1938	431	120	10	561	[1] 3,970,196	[1] 380,955	[1] 283,020	4,634,171
1939	435	103	7	545	3,933,785	574,770	142,250	4,650,805
1940	461	86	10	557	4,196,694	431,952	92,567	4,721,213
1941	420	136	6	562	4,180,588	538,381	141,225	4,860,194
1942	430	92	1	523	4,496,843	459,756	43,400	4,999,999

[1] New basis; for complete information see Bureau of Mines Information Circular 7034.

The increase in production of 100-octane aviation fuel from 40,000 barrels to 120,000 barrels daily was one of the most important defense projects initiated in 1941. Efforts in this direction include concentration on production of crude oils yielding high-octane gasoline, increasing the production of butane, diversion of butane from other uses to serve as a source of iso-octane, isomerization of butane, and raising the tolerance of tetraethyl lead from 3 cc. to 4 cc. per gallon of gasoline.

The high boiling range of iso-octane, 225°–263° F. (see Minerals Yearbook, 1940, Review of 1939, p. 991), necessitates blending it with other agents to produce an aviation fuel of required volatility. These blending agents usually are a light-gravity cut of straight-run gasoline of high octane number or a catalytically cracked gasoline, with isopentane. The naphthenic-base crude oils, which traditionally have been considered less desirable because of their low gasoline content, make the highest-octane gasoline, although the cut suitable for use as an aviation-fuel blending agent usually is very small. Texas, California, and Louisiana are the sources for most crude oils of this type.

The need for increasing the production of butane is most essential, both for the production of 100-octane fuel and for the synthesis of rubber. Greater efficiency in its recovery and the use of more absorber oil should supply a quantity that heretofore has been wasted, estimated by one authority at 15,000 barrels daily compared with 40,000 barrels used. An additional amount probably will have to be produced from the cracking of oils.

The program also contemplates the diversion of butane used as liquefied petroleum gas, which is burned by about 2 million users on farms, in homes, and in industrial plants that have no convenient access to gas mains. Sales of this product, totaling 7,463,000 barrels in 1940 and estimated at about 11,500,000 barrels in 1941, comprised 1,835,000 barrels of butane, 2,600,000 barrels of propane, 2,937,000 barrels of butane-propane mixtures, and 91,000 barrels of pentane. Twenty-eight percent of the butane and 35 percent of the butane-propane mixtures served for domestic uses; 43 percent of the butane and 3 percent of the mixtures served for industrial uses; 14 percent of the butane and 34 percent of the mixtures were used in internal-combustion engines—principally trucks; 14 percent of the butane and 3 percent of the mixtures were used by gas companies; and 25 percent of the mixtures was used in chemical manufacture. These users probably will have to depend largely on propane, 63 percent of which was consumed by domestic users and 30 percent for industrial fuel in 1940.

Isomerization is the changing of one chemical compound to another with the same percentage composition and molecular weight but with different physical properties. Applied to butane, it is the process of changing that gas, which is inert in the alkylation process, to isobutane. The most usual raw materials for alkylation (which, as it pertains to the petroleum industry, brings about direct union of a paraffin molecule with an olefin molecule) are isobutane (C_4H_{10}) and butene (C_4H_8). When these products are alkylated they produce iso-octane (C_8H_{18}), a saturated isoparaffin. Small proportions of natural gas consist of butane and isobutane, both constituents having the same chemical formula but isobutane having what is termed a "branched-chain molecule." To be used in the alkylation process, the butane must be isomerized to isobutane by a catalytic process.

Considerable research has been made on isomerization in recent years, and several processes have been developed. Aside from their principal use of converting butane to isobutane, they can be applied (although not economically at present) to other hydrocarbons to produce the iso, or branched-chain molecules, which make a higher-octane fuel than normal molecules. Construction of a number of butane isomerization plants was started in 1941.

It is sometimes necessary to convert butane to butene by dehydrogenation where the still gases do not furnish sufficient olefins to make a balanced feed stock for the alkylation process. This is done by removing 2 hydrogen atoms from the butane molecule by catalytic reaction, changing it from C_4H_{10} to C_4H_8.

The deleterious effect of tetraethyl lead on motors long ago made it necessary to limit the proportion of this antiknock component in motor fuel. Although the Navy has permitted as much as 6 cc. a gallon to be used in its aviation fuel, specifications for all military gasoline in the recent past have set the limit at 3 cc. In December 1941 the maximum was raised to 4 cc. This will result in greater production of 100-octane gasoline by permitting lower-octane blending agents to be used.

Several hydroforming plants for aromatization of the nonaromatic constitutents of naphtha were either put in operation or were under construction during 1941. One such plant was designed to produce

a new solvent claimed to be superior in many ways to present solvents. Hydroforming, though, is of even more immediate importance in the production of toluene, essential in the manufacture of explosives. The proportion obtainable through aromatization of crude oil is very small, and the aromatic naphtha produced by the hydroforming process must go through several highly complicated operations for separation and purification of the toluene.

It is estimated that war needs will require about 1,500,000 barrels of toluene annually. Although production from coking operations amounted to approximately 700,000 barrels in 1941, most of this was required in the chemical industry and could be diverted only at a serious loss. The hydroforming plants now under construction probably will be able to supply the needs for this product, although not all of these plants have provided for production of toluene.

The synthetic rubber industry will compete with 100-octane gasoline for the supply of butane. Because almost all natural rubber comes from the East Indies, Japan's declaration of war precipitated a problem that theretofore had been considered only as a long-time project—that of manufacturing rubber. Of all the major countries at war, the United States is the best-situated to meet this problem. Although Germany and Russia have had more experience in producing synthetic rubber for practical use, they—particularly Germany—do not have the petroleum resources available to this country. The petroleum industry has been called upon to furnish rubber at the rate of 400,000 tons annually within 18 months. Butadiene, from which petroleum-synthesized rubber is polymerized (see Minerals Yearbook, Review of 1940, pp. 978–979), is made from butane and must share the supply of this gas with 100-octane gasoline.

MOTOR FUEL

Demand.—Total demand and domestic demand for motor fuel were both 12 percent higher than in 1940 (see fig. 8).

Domestic motor-fuel demand per motor vehicle in use increased from 19.7 barrels (827 gallons) in 1940 to 20.4 barrels (857 gallons) in 1941. Toll-bridge and other traffic statistics indicate that the truck traffic did not participate in the increased gasoline consumption to as great an extent as did passenger cars. Of 16 bridges in Kentucky, 13 showed a smaller proportion of truck traffic than in 1940, the average for all declining from 20.1 percent to 17.9 percent of the total passenger-car and truck traffic. Of 15 points throughout the rest of the country, 10 showed a smaller proportion of trucks, and the average for the 15 declined from 12.5 percent to 11.7 percent. This interruption in the increasing trend of truck traffic is reflected in the table entitled "Motor-fuel consumption per motor-vehicle unit in use on July 1, 1925–41."

Calculations from the gasoline-temperature index indicate that, because of favorable weather, gasoline consumption was 3,199,000 barrels more than might normally have been expected, particularly during the last 4 months of the year, as the spring, with the exception of April, was backward.

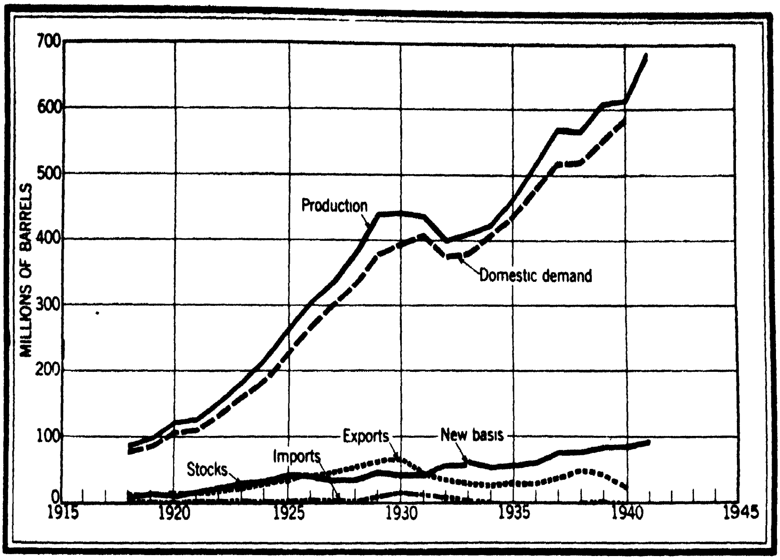

FIGURE 8.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel in the United States, 1918-41.

Comparative analyses of statistics for motor fuel in the United States in 1941, by months [1]

[Thousands of barrels]

	1941 [1]						
	Jan.	Feb.	March	April	May	June	July
Production	52, 542	48, 374	53, 409	53, 768	58, 258	56, 987	59, 609
Daily average	1, 695	1, 728	1, 723	1, 792	1, 879	1, 900	1, 923
Imports			1				
Exports	2, 045	1, 253	1, 738	1, 528	1, 588	1, 262	1, 416
Daily average	66	45	56	51	51	42	46
Stocks, end of period	88, 800	93, 920	96, 832	93, 918	91, 281	88, 646	83, 746
Domestic demand	45, 344	42, 001	48, 760	55, 154	59, 307	58, 360	63, 093
Daily average	1, 463	1, 500	1, 573	1, 838	1, 913	1, 945	2, 035

	1941 [1]						1940 (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production	60, 740	60, 167	62, 288	61, 243	63, 573	690, 958	616, 695
Daily average	1, 959	2, 006	2, 009	2, 041	2, 050	1, 893	1, 685
Imports	363	232	(2)	(2)	(2)	[2] 596	97
Exports	2, 700	2, 475	(2)	(2)	(2)	[2] 16, 005	25, 377
Daily average	87	82	(2)	(2)	(2)	[2] 59	69
Stocks, end of period	79, 205	78, 134	79, 568	83, 935	90, 688	90, 688	83, 647
Domestic demand	62, 944	58, 995	(3)	(3)	(3)	(3)	589, 490
Daily average	2, 030	1, 967	(3)	(3)	(3)	(3)	1, 611

[1] Subject to revision.
[2] Figures for imports and exports for 1941 cover January to September, inclusive.
[3] Publication suspended.

Motor-fuel consumption per motor-vehicle unit in use on July 1, 1925–41 [1]

Year	Passenger cars: Consumption (thousands of barrels)	Passenger cars: Number of vehicles	Passenger cars: Consumption per unit (barrels)	Trucks: Consumption (thousands of barrels)	Trucks: Number of vehicles	Trucks: Consumption per unit (barrels)
1925	154,938	15,453,300	10.03	43,104	2,372,400	18.17
1926	181,239	17,120,300	10.59	49,420	2,682,900	18.42
1927	205,983	18,413,800	11.19	55,397	2,906,000	19.06
1928	227,497	19,026,000	11.96	60,764	3,024,300	20.09
1929	256,899	20,532,800	12.51	68,346	3,194,300	21.40
1930	270,347	21,306,300	12.69	70,140	3,382,700	20.73
1931	276,828	20,854,700	13.27	70,746	3,397,100	20.83
1932	257,703	19,912,400	12.94	64,538	3,290,200	19.62
1933	258,365	19,510,300	13.24	67,058	3,234,700	20.73
1934	277,735	20,127,300	13.80	74,949	3,355,700	22.33
1935	294,686	20,760,100	14.19	82,545	3,581,400	23.05
1936	324,078	22,007,900	14.73	93,991	3,922,000	23.97
1937	347,034	23,435,600	14.81	103,739	4,223,200	24.56
1938	351,015	23,875,400	14.70	102,693	4,301,900	23.87
1939	369,521	24,342,900	15.18	112,582	4,389,200	25.65
1940 [2]	393,015	25,339,300	15.51	118,656	4,579,500	25.91
1941 [2]	444,524	27,328,100	16.27	127,538	4,887,000	26.10

[1] Excludes gasoline consumed by busses and for nonautomotive uses.
[2] Subject to revision.

Gasoline-temperature index and estimated influence of weather on motor-fuel demand in the United States in 1941, by months [1]

Month	Gasoline-temperature index [2]	Influence on motor-fuel demand (thousands of barrels)	Month	Gasoline-temperature index [2]	Influence on motor-fuel demand (thousand of barrels)
January	1.6	−27	September	2.5	453
February	−.7	−440	October	3.6	959
March	−2.5	−206	November	3.0	719
April	4.2	1,097	December	4.0	1,065
May	2.8	618			
June	1.1	−387			
July	1.5	−176	Average index	1.8	
August	.8	−476	Total influence		3,199

[1] See Breakey, Herbert A., Trends and Seasonal Variations in Factors Influencing Domestic Motor-Fuel Demand: Bureau of Mines Ec. Paper 21, 1940, pp. 19–31 and 61–65.
[2] In degrees departure from 46-year normal.

Production.—Motor-fuel production increased 12 percent—from 616,695,000 barrels in 1940 to 690,958,000 in 1941. The production in 1941 comprised 279,272,000 barrels of straight-run gasoline, 344,013,000 barrels of cracked gasoline, 3,469,000 barrels of benzol, and 64,204,000 barrels of natural gasoline. Natural gasoline used in producing motor fuel consisted of 47,825,000 barrels blended at the refineries and 17,808,000 barrels sold as such, including 1,429,000 barrels withdrawn from stocks in addition to the quantity produced.

Straight-run gasoline represented only 40.4 percent of the motor fuel produced, compared with 42.7 percent in 1940, whereas the proportion of cracked gasoline increased from 47.7 percent to 49.8. The ratio for natural gasoline blended at refineries was 6.9 percent, and that sold directly as such was 2.6 percent—a total of 9.5 percent compared with 9.0 percent in 1940. These figures include 0.2 percent contributed from stocks rather than production in 1941.

Production of gasoline in the United States in 1941, by methods of manufacture, districts, and months [1]

[Thousands of barrels]

Method and district	January	February	March	April	May	June	July	August	September	October	November	December	Total
Straight run:													
East Coast	2,215	2,153	2,874	2,336	2,392	2,427	2,617	2,521	2,565	2,639	3,171	2,822	30,732
Appalachian	834	725	823	883	949	948	880	873	922	923	870	846	10,476
Indiana, Illinois, Kentucky, etc.	4,099	3,747	4,131	4,303	4,915	4,707	4,609	4,682	5,199	5,389	5,236	5,357	56,374
Oklahoma, Kansas, and Missouri	2,369	2,399	2,705	2,481	2,742	2,783	2,885	3,021	2,730	2,946	2,751	2,812	32,624
Texas Inland	1,360	1,234	1,493	1,610	1,657	1,717	1,789	1,708	1,744	1,534	1,638	1,836	19,320
Texas Gulf Coast	5,027	4,823	4,445	4,967	5,248	4,488	5,046	5,595	4,900	5,057	4,876	5,313	59,785
Louisiana Gulf Coast	802	877	703	747	906	862	944	984	872	793	948	1,008	10,446
Arkansas and Louisiana Inland	582	491	563	567	633	520	675	697	683	681	642	705	7,439
Rocky Mountain	718	627	738	788	709	746	803	766	875	808	703	775	9,056
California	3,347	3,036	3,520	3,449	3,730	3,942	3,714	3,943	3,549	3,942	3,409	3,439	43,020
Total straight run	21,353	20,112	21,995	22,131	23,881	23,140	23,962	24,790	24,039	24,712	24,244	24,913	279,272
Percent yield [2]	19.3	20.0	19.8	19.9	20.0	19.9	19.8	20.0	19.8	19.5	19.9	19.9	19.8
Cracked:													
East Coast	3,815	3,433	3,798	4,289	4,621	4,340	4,542	4,517	4,355	4,990	4,761	5,202	52,663
Appalachian	1,214	1,056	1,161	1,144	1,172	1,170	1,363	1,265	1,271	1,229	1,221	1,381	14,647
Indiana, Illinois, Kentucky, etc.	5,780	5,258	5,899	5,306	6,265	6,468	7,026	6,638	6,697	6,795	6,342	6,262	74,736
Oklahoma, Kansas, and Missouri	2,486	2,277	2,712	2,634	2,904	2,726	2,897	3,001	3,152	3,185	3,027	3,063	34,064
Texas Inland	1,320	1,402	1,288	1,269	1,303	1,311	1,389	1,548	1,462	1,697	1,407	1,645	17,041
Texas Gulf Coast	7,331	6,469	7,349	7,695	8,369	8,193	8,899	8,447	8,558	8,861	9,078	9,821	99,070
Louisiana Gulf Coast	712	683	718	797	788	850	884	874	870	946	932	986	10,040
Arkansas and Louisiana Inland	369	333	394	402	452	331	463	413	405	446	406	423	4,837
Rocky Mountain	717	543	623	537	746	569	726	805	671	646	806	597	7,986
California	2,248	1,963	2,239	2,307	2,288	2,520	1,935	2,526	2,757	2,533	2,738	2,875	28,929
Total cracked	25,992	23,417	26,181	26,380	28,908	28,478	30,124	30,034	30,198	31,328	30,718	32,255	344,013
Percent yield [2]	23.5	23.3	23.6	23.8	24.2	24.6	24.8	24.1	24.8	24.7	25.3	25.8	24.4
Total production including natural gasoline:													
East Coast	6,239	5,765	6,821	6,753	7,142	6,871	7,294	7,183	7,105	7,814	8,136	8,256	85,379
Appalachian	2,082	1,822	2,026	2,078	2,158	2,147	2,281	2,165	2,240	2,196	2,134	2,277	25,606
Indiana, Illinois, Kentucky, etc.	10,469	9,545	10,575	10,201	11,732	11,728	12,234	11,944	12,568	12,913	12,253	12,319	138,481
Oklahoma, Kansas, and Missouri	5,283	5,028	5,793	5,450	5,973	5,817	6,119	6,402	6,361	6,574	6,255	6,333	71,388
Texas Inland	3,442	3,231	3,423	3,428	3,537	3,623	3,770	3,924	3,890	4,006	3,690	4,179	44,143
Texas Gulf Coast	12,880	11,748	12,405	13,309	14,214	13,386	14,631	14,896	14,566	14,964	14,954	16,251	168,204
Louisiana Gulf Coast	1,539	1,579	1,455	1,568	1,726	1,734	1,850	1,951	1,844	1,867	2,011	2,141	21,265
Arkansas and Louisiana Inland	1,004	869	992	1,002	1,112	881	1,171	1,219	1,199	1,267	1,136	1,227	13,079
Rocky Mountain	1,525	1,244	1,424	1,377	1,511	1,365	1,568	1,627	1,601	1,529	1,600	1,460	17,831
California	6,710	6,010	7,036	6,843	7,083	7,584	6,796	7,643	7,614	7,907	7,311	7,197	85,734
Total United States: 1941	51,173	46,841	51,950	52,009	56,188	55,136	57,714	58,954	58,988	61,037	59,480	61,640	671,110
1940	48,985	46,253	49,493	48,784	50,444	49,281	49,684	50,799	51,088	51,726	49,795	51,043	597,375

[1] Subject to revision.

[2] Based upon crude runs to stills.

Yields.—The yield of gasoline, which had dropped from 45.0 percent of the crude oil run to stills in 1939 to 43.1 percent in 1940, partly recovered in 1941 to 44.2 percent. The yield of straight-run gasoline, however, continued its downward trend, slipping from 20.4 percent in 1940 to 19.8 in 1941, whereas cracked gasoline, in response to increased re-forming, additional catalytic cracking, and other improved methods of motor-fuel production, rose from 22.8 percent in 1940 to 24.4 percent in 1941. The yields of straight-run gasoline stayed within a narrow range throughout the year, showing no trend, but those of cracked gasoline rose almost every month from a low of 23.3 percent in February to a high of 25.8 percent in December when the total yield was 45.7 percent.

Greatest gains in yields were in the Texas Gulf Coast, Louisiana Gulf Coast, California, and East Coast districts, which increased 2.7, 1.7, 1.6, and 1.4 percent, respectively. Yields in the Rocky Mountain, Appalachian, Indiana, Illinois, Kentucky, etc., and Inland Louisiana-Arkansas districts declined 1.1, 0.9, 0.8, and 0.6 percent, respectively.

Prices.—There were few advances in the refinery price of regular-grade gasoline after the request of the Office of Price Administration and Civilian Supply late in May to make no more increases without prior consultation with that office; in fact, the last one occurred early in July. During this period the Mid-Continent price for regular-grade gasoline rose from an average of 4.75 cents to 6.19 cents, at which quotation it held for the remainder of the year. Premium grade continued to advance until November 28, although a ceiling had been established in the Gulf Coast area on September 4. The Mid-Continent price for this grade rose from an average of 4.94 cents at the beginning of the year to 7.15 cents after the last increase.

Service-station prices for gasoline advanced steadily throughout the year until December 1, and thereafter suffered a late seasonal decline. Most of these gains occurred within the first 8 months of the year, as the Office of Price Administration and Civilian Supply established a ceiling for them on August 28 for 40 cities in the northern part of the East Coast district. There were only a few increases after that date, principally in the Southeast and Midwest.

The posted price does not indicate the real amount received for the gasoline, as under the dealer-marketing plan now in effect in most States a retailer determines his own price for the gasoline he sells. At the beginning of the year discounts from the posted price, ranging as high as 3 cents a gallon, were quite general in some places. However, by the end of the year they had been nearly eliminated, owing partly to the strong demand for gasoline during the third quarter (which taxed the sources of supply) and partly to the shortage of gasoline on the East coast caused by the loan of tankers to Great Britain, with the resultant difficulty of transporting oils from the Gulf Coast area to the East coast.

The greatest change occurred in the East Coast district, where the averages increased 2.49 cents for South Atlantic cities and 1.91 cents for North Atlantic cities. These gains were particularly significant because almost one-third of the motor-fuel demand is marketed in this district. The price in Salisbury, N. C., increased the greatest—4.45 cents (from 10.50 cents (ex tax) to 14.95), and Charlotte, N. C., followed closely, with an increase from 10.00 cents to 14.40. The price in Burlington, Vt., increased 3.9 cents (from 9.80 cents to 13.70);

that in Syracuse, N. Y., increased 3.6 cents and that in Atlanta, Ga., and Manchester, N. H., 3.5 cents each. Des Moines, Iowa, where the price dropped from 12.90 cents to 10.90, had the greatest decrease of the few cities where gasoline prices declined.

Average monthly prices of gasoline in the United States, 1940–41, in cents per gallon

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1940													
Monthly average at refineries in Oklahoma [1]													
67-69 octane (L-3) [2]	4.67	4.46	4.43	4.43	----	----	----	----	----	----	----	----	4.50
72-74 octane (A. S. T. M.) [2]	--	----	----	5.00	5.00	5.00	5.00	4.94	4.89	4.79	4.75	4.75	4.90
Average of 50 cities on 1st of month [3]													
Dealers' net	9.78	9.73	9.61	9.42	9.24	9.00	8.91	8.91	8.69	8.59	8.58	8.46	9.08
Service station (including State tax)	17.95	17.85	17.76	17.59	17.33	17.08	16.95	17.00	16.73	16.60	16.61	16.49	17.16
1941													
Monthly average at refineries in Oklahoma 72-74 octane [1]	4.72	4.69	4.71	5.09	5.47	5.99	6.18	6.19	6.19	6.19	6.19	6.19	5.65
Average of 50 cities on 1st of month [3]													
Dealer's net	8.54	8.54	8.62	8.78	9.40	9.85	9.94	10.04	10.02	10.04	10.02	10.04	9.49
Service station (including State tax)	16.57	16.58	16.67	16.82	17.53	18.14	18.26	18.32	18.39	18.49	18.49	18.52	17.73

[1] National Petroleum News
[2] 67-69 octane (L-3 method) discontinued April 11, 72-74 octane (A. S. T. M. method) initiated April 8.
[3] American Petroleum Institute, compiled by The Texas Co.

Despite the increases, the cities along the North Atlantic coast had the lowest average price for gasoline—12.59 cents (ex tax)—followed by the cities in the central part of the United States, where the prices averaged 12.87 cents.

The average price for the Rocky Mountain area rose from 13.75 cents (revised) on December 31, 1940, to 15.00 cents on December 31, 1941, to make it again the highest for the country, although the Pacific Coast area followed closely with an average of 14.80 cents.

The highest prices paid by motorists for gasoline, including State, City, and Federal taxes, on January 1, 1942, were 25.1 cents at Twin Falls, Idaho, and 24.1 cents at Boise, Idaho (each including 6.6 cents tax). The price in Montgomery, Ala., was 24.0 cents (including 9.5 cents tax); in Knoxville, Tenn., 23.50 (including 8.5 cents tax); in Charleston, W. Va., 23.05 cents (including 6.5 cents tax); and in Pensacola, Fla., 23.00 cents (including 9.5 cents tax). Motorists in Des Moines, Iowa, paying 15.4 cents a gallon, enjoyed the lowest price for their gasoline, although the service-station price in the principal Oklahoma cities was only 15.5 cents until a 1½-cent increase in the State gasoline tax on July 1 raised it to 17 cents.

Another advantage to refiners, in addition to the price advance, was the lower quality of motor fuel. One feature of gasoline quality had been its continual improvement for several years at no additional cost to consumers. (See Minerals Yearbook, Review of 1940, pp. 985–986.) During 1941, however, the military requirements for high-octane fuel resulted in a reversal of this trend to divert some of the high-octane qualities to military fuel. The rating for regular-grade gasoline, for

which the Western Refiners Association in 1940 had adopted the specification of 72–74 octane, was found in the Bureau of Mines Cooperative Fuel Research Motor-Gasoline Survey for the Summer of 1941 (see Report of Investigations 3611) to average almost 75 octane for the country as a whole. Late in 1941 the refiners in the Gulf Coast area reduced this grade to 71–72 octane and the premium grade from 80 to 78. Refiners in other parts of the country followed with similar reductions. Pressure brought on refiners to lower octane rating was due to a shortage in the raw materials for tetraethyl lead, which resulted in the Ethyl Gasoline Corporation rationing its supply of lead for civilian uses to meet military requirements.

Gasoline tax rates were increased in two States and the District of Columbia in 1941. Minnesota, which permitted its emergency tax of 1 cent a gallon to lapse on September 1, 1940, reestablished it, effective May 1, 1941, raising the tax from 3 cents to 4 cents. The tax in Oklahoma was increased from 5½ cents to 7 cents, effective July 1, and that in the District of Columbia from 2 cents to 3 cents, effective January 1, 1942. At the beginning of 1942 4 States had a tax rate of 7 cents, 1 of 6½ cents, 5 of 6 cents, 10 of 5 cents, 18 of 4 cents, 9 and the District of Columbia of 3 cents, and 1 of 2 cents.

Aviation gasoline.—Production of aviation gasoline in 1941 increased by about 50 percent, and more capacity was being added toward the end of the year as this country prepared to supply its allies with high-octane fuel for their war planes.

There were no changes in prices of aviation gasolines during 1941. Tank-wagon prices quoted by the Standard Oil Company of Ohio throughout the year were: Sohio Aviation, 14.5 cents; 74-octane, 15.5 cents; 87-octane, 16.5 cents; 100-octane, 24.5 cents.

Stocks.—Motor-fuel stocks were considerably lower throughout most of 1941 than they had been in 1940, and they maintained a more normal relationship throughout the year. The peak of 98,706,000 barrels of finished and unfinished gasoline on March 31 was 5 million barrels less than the peak on the same date in 1940 and represented only 52.2 days' supply compared with the 62.5 days' supply on March 31, 1940. Stocks again exceeded those of 1940 in October and totaled 94,098,000 barrels by December 31 compared with 84,409,000 barrels at the end of 1940. The days' supply on this date was 55.9 compared with 55.2 at the end of 1940.

All of the districts had larger stocks at the end of the year than at the beginning. The greatest gains occurred in the East Coast and Indiana, Illinois, Kentucky, etc., districts, the increase being 2,250,000 barrels (12.1 percent) in the former and 2,444,000 (15.4 percent) in the latter. Although stocks in the Texas Gulf Coast district gained 1,398,000 barrels—from 14,433,000 to 15,831,000—more than half of this was in unfinished gasoline, leaving the gain in finished gasoline only 663,000 barrels. This indicates how the refiners in the Gulf Coast area took advantage of the return in October of some of the tankers loaned to Great Britain to move gasoline to the East coast, where stocks increased 2 million barrels from the end of September to the end of December compared with a decline of almost that amount during the same period in 1940.

Stocks in the East Coast district dropped only a little below those of 1940 during the heavy consuming period, notwithstanding transportation difficulties. This was probably due to measures adopted by

Days' supply of motor fuel on hand in the United States at end of month, 1939–41 [1]

Month	1939 Finished gasoline	1939 Natural gasoline	1939 Total motor fuel	1940 [2] Finished gasoline	1940 [2] Natural gasoline	1940 [2] Total motor fuel	1941 [3] Finished gasoline	1941 [3] Natural gasoline	1941 [3] Total motor fuel
January	54.6	3.5	58.1	62.3	3.3	65.6	53.9	3.6	57.5
February	52.1	3.1	55.2	61.3	3.2	64.5	54.4	3.3	57.7
March	50.8	3.0	53.8	58.2	3.2	61.4	48.4	2.8	51.2
April	46.6	3.2	49.8	54.5	3.4	57.9	45.0	2.8	47.8
May	43.1	3.4	46.5	48.3	3.3	51.6	43.0	2.9	45.9
June	42.5	3.8	46.3	48.1	3.9	52.0	39.6	3.0	42.6
July	38.3	3.7	42.0	44.2	4.1	48.3	36.6	3.0	39.6
August	37.1	3.7	40.8	42.7	4.2	46.9	35.7	3.0	38.7
September	38.1	3.4	41.5	42.0	3.9	45.9	37.0	2.7	39.7
October	40.9	3.1	44.0	42.9	3.8	46.7	39.4	2.6	42.0
November	47.3	3.0	50.3	47.0	3.9	50.9	43.3	2.5	45.8
December	56.2	3.2	59.4	51.0	3.7	54.7	51.3	2.5	53.8

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Revised figures. [3] Subject to revision.

the Petroleum Coordinator and the industry to meet the emergency. In addition to the publicity that served in the nature of a warning to the public, alternative methods of transportation were established (see Distribution), with the result that there was no real distress.

Figure 9 shows the monthly quantities of finished gasoline stocks, in millions of barrels, from January 1, 1937, to December 31, 1941.

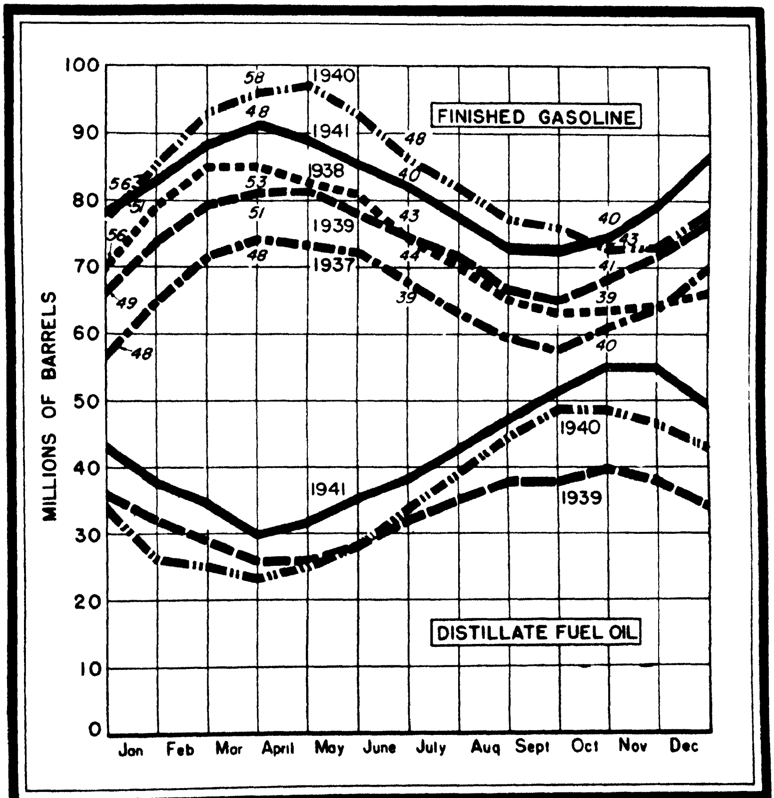

FIGURE 9.—Stocks of finished gasoline in the United States, 1937–41, by months, with figures representing days' supply at certain periods, also stocks of distillate fuel oil, 1939–41, by months.

Stocks of gasoline in the United States in 1941, by districts and months [1]

[Thousands of barrels]

District	January 31	February 28	March 31	April 30	May 31	June 30	July 31	August 31	September 30	October 31	November 30	December 31
Finished gasoline: [2]												
East Coast	18,790	18,936	19,746	20,101	21,504	21,585	20,589	19,375	17,949	18,642	19,591	19,956
Appalachian	3,151	3,189	3,169	3,054	3,058	2,927	2,810	2,935	3,148	3,095	3,223	3,410
Indiana, Illinois, Kentucky, etc	17,292	19,272	20,206	18,772	17,284	17,148	16,114	14,863	14,936	15,460	16,222	17,662
Oklahoma, Kansas, and Missouri	7,618	8,249	8,747	8,039	7,482	7,073	6,227	6,237	6,507	7,105	7,754	8,402
Texas Inland	2,372	2,511	2,447	2,360	2,231	2,175	2,146	2,170	2,122	2,156	2,246	2,653
Texas Gulf Coast	13,246	14,812	15,184	14,914	13,429	11,550	11,038	9,940	10,462	10,399	11,128	13,843
Louisiana Gulf Coast	2,743	3,084	3,254	3,242	3,059	2,988	2,982	3,050	2,571	2,135	2,518	3,165
Arkansas and Louisiana Inland	813	831	819	836	781	692	660	590	633	633	710	794
Rocky Mountain	1,978	2,277	2,405	2,327	2,209	1,919	1,633	1,324	1,267	1,259	1,552	1,729
California	15,307	15,448	15,524	14,769	14,388	14,354	13,230	12,610	13,166	13,814	14,434	14,799
Total finished gasoline	83,310	88,609	91,501	88,414	85,425	82,411	77,429	73,094	72,761	74,698	79,378	86,413
Unfinished gasoline:												
East Coast	946	1,058	1,151	1,061	1,124	1,029	1,066	1,162	1,163	1,204	1,072	916
Appalachian	458	448	459	434	395	365	380	331	329	315	297	274
Indiana, Illinois, Kentucky, etc	715	651	576	596	562	638	555	561	494	536	571	665
Oklahoma, Kansas, and Missouri	648	637	483	516	474	522	574	528	486	527	502	473
Texas Inland	399	322	518	567	607	634	623	694	822	902	923	635
Texas Gulf Coast	1,590	1,596	1,877	1,876	1,921	1,958	1,940	1,727	1,599	1,592	1,821	1,988
Louisiana Gulf Coast	425	386	427	439	406	363	417	339	352	402	475	449
Arkansas and Louisiana Inland	22	30	34	28	13	18	12	13	14	14	16	12
Rocky Mountain	93	89	88	100	106	117	106	104	106	90	91	80
California	1,760	1,732	1,592	1,738	1,798	1,703	1,599	1,824	1,837	2,023	2,132	2,193
Total unfinished gasoline	7,056	6,949	7,205	7,355	7,406	7,347	7,272	7,283	7,202	7,605	7,900	7,685
Total finished and unfinished												
East Coast	19,736	19,994	20,897	21,162	22,628	22,614	21,655	20,537	19,112	19,846	20,663	20,872
Appalachian	3,609	3,637	3,628	3,488	3,453	3,292	3,190	3,266	3,477	3,410	3,520	3,684
Indiana, Illinois, Kentucky, etc	18,007	19,923	20,782	19,368	17,846	17,786	16,669	15,424	15,430	15,996	16,793	18,327
Oklahoma, Kansas, and Missouri	8,266	8,886	9,230	8,555	7,956	7,595	6,801	6,765	6,993	7,632	8,256	8,875
Texas Inland	2,771	2,833	2,965	2,927	2,838	2,809	2,769	2,864	2,944	3,058	3,169	3,288
Texas Gulf Coast	14,836	16,408	17,061	16,790	15,350	13,508	12,978	11,667	12,061	11,991	12,949	15,831
Louisiana Gulf Coast	3,168	3,470	3,681	3,681	3,465	3,351	3,399	3,389	2,923	2,537	2,993	3,614
Arkansas and Louisiana Inland	835	861	853	864	794	710	672	603	647	647	726	806
Rocky Mountain	2,071	2,366	2,493	2,427	2,315	2,036	1,739	1,428	1,373	1,349	1,643	1,809
California	17,067	17,180	17,116	16,507	16,186	16,057	14,829	14,434	15,003	15,837	16,566	16,992
Total United States: 1941	90,366	95,558	98,706	95,769	92,831	89,758	84,701	80,377	79,963	82,303	87,278	94,098
1940	90,975	99,295	103,710	103,563	100,859	93,569	89,065	83,701	81,907	79,185	79,517	84,409

[1] Subject to revision.

[2] Includes stocks of finished gasoline at refineries, bulk terminals, and pipe lines.

The figures for days' supply on the chart represent the quantity of finished gasoline on hand at the end of the month divided by the total demand for the succeeding month.

Figure 9 also shows the stocks of distillate fuel oil for 1939–41, to stress the contrast in seasonal variations in stocks of the two products. It also shows the effect of the warm autumn of 1941 on the accumulation of a generous supply of heating oil, which was fortunate for the East Coast district, where distress might have been occasioned because of lack of transportation facilities for oil had the fall and winter been severe.

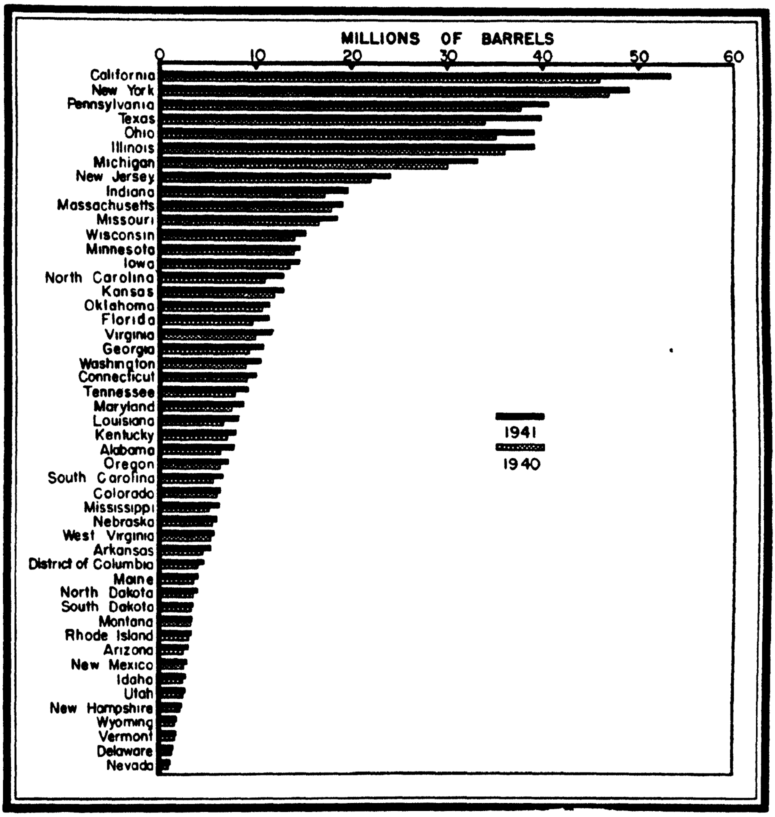

FIGURE 10.—Consumption of gasoline in the United States, 1940–41, by States.

Production and consumption by States.—Texas increased its relative standing by furnishing 32 percent of the gasoline produced in 1941. Percentages for the next important States were California, 13; Pennsylvania, 8; and Indiana and Illinois, 7 each.

The same six States that led in gasoline consumption in 1940 were highest in 1941, but California took first place and Texas stepped up to fourth (see fig. 10). The percentage consumption of the principal States was as follows: California, 8.3; New York, 7.7; Pennsylvania, 6.3; Texas, 6.2; Ohio, 6.1; Illinois, 6.1; Michigan 5.2.

Distribution.—The withdrawal of a large number of tankers from domestic service during the summer and fall of 1941 for loan to Great

Britain necessitated considerable change in gasoline-transportation channels. Fullest use was made of tank cars, and this movement amounted to about 150,000 barrels a day during the heavy motoring period. Although domestic shipments of gasoline on the Mississippi River and its tributaries had increased from 59,183,000 barrels in 1939 (unadjusted for duplications) to only 60,289,000 in 1940 (the latest data available), barge movement up the Mississippi River in 1941 almost doubled and amounted to 13,736,000 barrels compared

Production and consumption of gasoline in the United States, 1939–41, by States

[Thousands of barrels]

State	1939		1940		1941 [1]	
	Production	Consumption [2]	Production	Consumption [2]	Production	Consumption [2]
Alabama	(3)	5,869	(3)	6,307	(3)	7,819
Arizona	-	2,550	-	2,637	-	3,051
Arkansas	3,452	4,339	3,702	4,546	4,044	5,340
California	[4] 79,774	43,760	[4] 76,885	45,904	[4] 85,734	53,359
Colorado	1,720	5,659	2,020	5,976	2,334	6,358
Connecticut	-	8,217	-	9,068	-	10,035
Delaware	-	1,391	-	1,495	-	1,622
District of Columbia	-	3,571	-	4,027	-	4,561
Florida	-	8,710	-	9,713	-	11,326
Georgia	[5] 4,646	8,531	[5] 4,329	9,346	[5] 4,983	10,713
Idaho	(6)	2,387	(6)	2,547	(6)	2,786
Illinois	[7] 33,538	33,803	[7] 41,386	35,944	[7] 49,377	38,987
Indiana	44,490	15,973	43,180	17,175	43,704	19,564
Iowa	-	13,103	-	13,637	-	14,578
Kansas	[8] 31,596	11,353	[8] 32,964	11,943	[8] 37,198	12,872
Kentucky	[9] 6,021	6,545	[9] 7,049	6,954	[9] 8,523	7,939
Louisiana	[3] 25,631	6,220	[3] 23,673	6,627	[3] 30,300	8,179
Maine	-	3,575	-	3,747	-	4,138
Maryland	(5)	6,945	(5)	7,491	(5)	8,703
Massachusetts	[10] 4,959	17,170	[10] 6,554	17,791	[10] 5,791	19,155
Michigan	7,932	27,455	10,216	29,979	11,180	33,149
Minnesota	(7)	13,111	(7)	13,861	(7)	14,481
Mississippi	-	4,988	(3)	5,219	(3)	6,163
Missouri	(8)	15,590	(8)	16,623	(8)	18,472
Montana	3,313	3,012	3,836	3,276	4,293	3,533
Nebraska	(6)	5,607	(6)	5,629	(6) (8)	5,989
Nevada	-	1,045	-	1,043	-	1,185
New Hampshire	-	2,204	-	2,282	-	2,430
New Jersey	28,539	20,776	25,451	22,023	28,312	23,991
New Mexico	[11] 3,056	2,427	[11] 3,320	2,630	[11] 3,698	2,909
New York	6,355	45,255	7,826	46,918	9,044	49,002
North Carolina	-	10,229	-	10,938	-	12,923
North Dakota	-	3,137	-	3,638	-	3,947
Ohio	24,943	32,649	31,603	35,022	34,816	39,031
Oklahoma	33,898	10,159	32,603	10,584	34,190	11,368
Oregon	-	5,826	-	6,250	-	7,230
Pennsylvania	47,014	35,296	46,550	37,666	51,419	40,594
Rhode Island	(10)	3,092	(10)	3,190	(10)	3,507
South Carolina	(5)	5,055	(5)	5,577	(5)	6,555
South Dakota	(6)	3,174	(6)	3,422	(6)	3,634
Tennessee	(9)	6,875	(9)	7,785	(9)	9,186
Texas	196,935	31,926	184,885	33,806	212,347	39,839
Utah	(11)	2,375	(11)	2,552	(11)	2,783
Vermont	-	1,619	-	1,686	-	1,790
Virginia	-	9,098	-	9,943	-	11,842
Washington	(4)	8,320	(4)	9,024	(4)	10,510
West Virginia	1,712	4,879	2,017	5,262	2,317	5,719
Wisconsin	-	13,494	-	14,049	(7)	15,148
Wyoming	[6] 6,977	1,619	[6] 7,230	1,668	[6] 7,506	1,882
Total United States	596,501	539,963	597,279	574,420	671,110	639,877

[1] Subject to revision.
[2] American Petroleum Institute.
[3] Alabama and Mississippi included with Louisiana.
[4] Washington included with California.
[5] Maryland and South Carolina included with Georgia.
[6] Idaho, western Nebraska, and South Dakota included with Wyoming.
[7] Minnesota and Wisconsin included with Illinois.
[8] Missouri and eastern Nebraska included with Kansas.
[9] Tennessee included with Kentucky.
[10] Rhode Island included with Massachusetts.
[11] Utah included with New Mexico.

with 7,941,000 in 1940. More significant, however, is the fact that the daily average, which was only 16,171 barrels for the first quarter of 1940, totaled 44,602 barrels for the peak months of June to September in 1941.

Notwithstanding the diversion of tankers, shipments of gasoline from the Gulf to the East coast increased from 119,142,000 barrels in 1940 to 130,534,000 in 1941, and even during the 5 months of the diversion period—June to October—they were 3,869,000 barrels more than for the same period in 1940. The tanker movement from California to the East coast, which gained 30 percent in the first 6 months of 1941 (from 1,737,000 barrels in 1940 to 2,251,000 in 1941) was completely stopped during the latter part of the year, so that the ships could be used for more necessary service. A small quantity of gasoline needed for special blending purposes continued to be moved across the country by railroad.

Shipments of motor fuel by pipe lines in the United States in 1941, by months

[Thousands of barrels]

	1940													1940 total
	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Motor fuel turned into lines	8,816	7,113	8,764	8,886	9,637	9,882	9,996	10,669	9,403	9,771	9,897	10,142	112,976	97,064
Motor fuel delivered from lines	7,683	6,814	8,363	9,365	10,190	9,685	10,494	10,288	9,518	9,709	9,438	9,530	111,077	96,657
Shortage	15	39	88	4	30	29	68	61	71	101	39	70	615	588
Stocks in lines and working tanks, end of month	6,192	6,452	6,765	6,282	5,699	5,867	5,301	5,621	5,435	5,396	5,816	6,358	6,358	5,074

Pipe-line shipments of motor fuel increased from 96,657,000 barrels in 1940 to 111,077,000 in 1941. Important additions to pipe lines in 1941 include the Southeastern Pipe Line from Port St. Joe, Fla., to Chattanooga, Tenn.—450 miles; the Plantation Pipe Line from Baton Rouge, La., to Greensboro, N. C.—1,260 miles; and a line from Fall River to Worcester and Waltham, Mass.—86 miles. Work was begun in 1941 on a line from Marcus Hook, Pa., and Baltimore, Md., to Greensburg, Pa., via Schaefferstown, Pa.

KEROSINE AND RANGE OIL

The domestic demand for kerosine in 1941 changed little from the 1940 total of 68,776,000 barrels, and exports remained at a very low level in 1941, as in 1940. Kerosine is seldom imported into the United States; however, small quantities were received in both 1940 and 1941. Production of kerosine in 1941 was below the 1940 output, but year-end stocks for the 2 years remained at about the same volume.

Although 9 percent more crude petroleum was run to stills in 1941 than in 1940, the production of kerosine declined by 2 percent (from 73,882,000 barrels in 1940 to 72,586,000 in 1941) owing to a pronounced reduction in the percentage yield. The 5.2-percent yield of kerosine in 1941 (the lowest since 1936) compares with a relative high output of 5.7 percent in 1940. Refiners adjusted their runs to stills in 1941 to produce relatively more motor fuel and heavy fuel oil and correspondingly less kerosine and distillate fuel oil; however,

because of the larger quantity of crude petroleum processed in 1941, the change provided enough kerosine to satisfy all demands and to increase stocks slightly.

Substantial gains in the production of kerosine were reported for the Indiana-Illinois and Louisiana Gulf Coast refinery districts in 1941 compared with 1940. Small increases in kerosine production were also realized in the Oklahoma-Kansas, Texas Inland, Arkansas-Louisiana Inland, and Rocky Mountain refinery areas. The out-

Comparative analyses of statistics for kerosine in the United States, 1940–41, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]
By months:								
January	5,375	6,661	5 0	6.0	7,642	7,769	4,918	8,312
February	5,945	5,888	5.8	5 9	6,263	6,484	4,302	7,634
March	6,570	6,033	6.0	5.4	6,273	6,821	4,114	6,724
April	6,257	6,068	5 8	5.5	5,621	5,549	4,351	7,063
May	6,641	6,033	5 9	5.1	5,297	4,504	5,309	8,421
June	5,785	5,218	5.4	4.5	3,952	3,918	6,810	9,609
July	5,797	5,406	5 4	4 5	4,257	4,270	8,191	10,635
August	5,629	5,850	5.2	4.7	4,114	4,449	9,476	11,636
September	6,062	5,949	5 6	4.9	5,173	5,624	10,254	11,662
October	6,496	6,355	5 9	5.0	5,608	(2)	11,000	11,670
November	6,431	6,443	6 1	5.3	6,768	(2)	10,473	10,843
December	6,894	6,682	6.3	5.3	7,808	(2)	9,512	9,599
Total United States	73,882	72,586	5.7	5 2	68,776	(2)	9,512	9,599
By districts:								
East Coast	11,447	9,169	5 6	4.2			2,428	2,489
Appalachian	3,213	3,166	6.7	5 9			183	311
Indiana, Illinois, Kentucky, etc.	10,344	11,864	4.6	4.7			983	1,168
Oklahoma, Kansas, and Missouri	7,196	7,505	6 3	5 9			481	618
Texas Inland	2,753	2,987	4.5	4 5	(3)	(3)	159	282
Texas Gulf Coast	26,164	24,448	7 7	6 7			3,154	2,949
Louisiana Gulf Coast	5,897	7,304	13 1	13 5			646	513
Arkansas and Louisiana Inland	2,722	3,080	11 0	10 5			224	213
Rocky Mountain	824	906	2.7	2.7			128	129
California	3,322	2,157	1.7	1 0			1,126	927
Total United States	73,882	72,586	5.7	5.2	68,776	(2)	9,512	9,599

[1] Subject to revision. [2] Publication suspended [3] Figures not available.

put of kerosine declined sharply in the East Coast, Texas Gulf Coast, and California districts, owing to the lack of an active export market and the change in refinery runs to yield more motor fuel and heavy fuel oil.

Year-end stocks of kerosine increased by 1 percent from 9,512,000 barrels in 1940 to 9,599,000 in 1941, both totals representing 51 days' supply at the prevailing demand in the respective years. There were some shifts in the proportionate quantities of kerosine held in the several refinery districts at the end of 1941 compared with 1940. The inventory credited to the Indiana-Illinois area increased from 10 percent of all kerosine in storage at the close of 1940 to 12 percent in 1941, whereas quantities in the Texas Gulf Coast district declined from 33 percent of the 1940 total to 31 percent in 1941. California stocks of kerosine in 1941, representing 10 percent of the national total, were proportionately 2 percent below the quantity reported at the end of 1940. The East coast stocks remained at approximately 26 percent of the total inventory for both 1940 and 1941.

Distributors reported sales of 67,662,000 barrels of kerosine for range-burner fuel, tractor fuel, and all other uses in 1940, a 13-percent gain over 1939 deliveries of 59,767,000 barrels. Range burners, widely used in the New England States and in New York, New Jersey, Pennsylvania, and Illinois and to a lesser degree in other areas, required the larger share of the marketed kerosine as fuel. Kerosine sold as range oil increased from 33,841,000 barrels in 1939 (57 percent of total kerosine sales) to 40,715,000 in 1940 (60 percent of total demand). Remaining kerosine deliveries in 1940 were reported as tractor fuel—4,683,000 barrels (4,346,000 in 1939)—and all other uses—22,264,000 barrels (21,580,000 in 1939).

Sales of kerosine in the United States, 1939–40, by regions, States, and uses [1]

[Thousands of barrels]

Region and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1939	1940	1939	1940	1939	1940	1939	1940
Pacific Coast:								
California	104	91	-------	13	1,170	985	1,274	1,089
Oregon	1	11	6	6	62	53	69	70
Washington	7	5	-------	-------	141	130	148	135
Arizona	6	5	-------	2	99	90	105	97
Nevada	1	-------	-------	-------	14	11	15	11
Rocky Mountain:								
Idaho	3	1	14	9	8	9	25	19
Montana	16	34	53	97	42	50	111	181
Wyoming	5	4	18	29	16	17	39	50
Utah	18	9	13	14	10	14	41	37
Colorado	24	20	75	69	51	46	150	135
New Mexico	25	18	28	41	43	61	96	120
North Central:								
North Dakota	56	54	171	168	59	66	286	288
South Dakota	77	102	130	143	73	59	280	304
Minnesota	207	278	244	262	476	457	927	997
Nebraska	114	130	176	180	181	144	471	454
Iowa	206	191	309	282	698	659	1,213	1,132
Wisconsin	208	188	201	208	558	516	967	912
Illinois	952	1,114	350	340	1,549	1,615	2,851	3,069
Indiana	152	179	124	168	1,102	1,211	1,378	1,558
Michigan	288	334	123	136	735	756	1,146	1,226
Ohio	279	322	206	212	800	791	1,285	1,325
Kentucky	56	60	48	60	456	510	560	630
Tennessee	113	116	79	68	434	460	626	644
South Central:								
Missouri	295	380	159	157	702	653	1,156	1,190
Kansas	168	178	200	191	282	209	650	578
Texas	279	306	425	509	1,414	1,611	2,118	2,426
Oklahoma	114	148	171	212	510	550	795	910
Arkansas	165	140	129	150	448	420	742	710
Louisiana	148	142	64	101	670	714	882	957
Mississippi	62	36	162	144	332	376	556	556
Alabama	89	61	24	18	366	377	479	456
New England:								
Maine	1,219	1,562	1	-------	46	42	1,266	1,604
New Hampshire	781	894	-------	-------	38	39	819	933
Vermont	468	560	-------	-------	84	73	552	633
Massachusetts	10,455	13,029	-------	-------	448	460	10,903	13,489
Rhode Island	2,111	2,547	-------	-------	82	80	2,193	2,627
Connecticut	3,219	3,793	2	2	151	140	3,372	3,935
Middle Atlantic:								
New York	5,772	7,110	132	148	1,180	1,352	7,084	8,610
New Jersey	2,804	3,316	36	28	1,229	1,295	4,069	4,639
Pennsylvania	619	830	160	124	1,388	1,412	2,167	2,366
Delaware	96	118	-------	4	56	63	152	185
Maryland	490	529	25	28	543	685	1,058	1,242
District of Columbia	71	78	2	5	85	92	158	175
South Atlantic:								
Virginia	186	198	9	19	576	658	771	875
West Virginia	33	29	3	10	181	191	217	230
North Carolina	513	573	94	80	652	678	1,259	1,331
South Carolina	166	171	34	32	434	425	634	628
Georgia	191	214	38	76	458	499	687	789
Florida	409	507	108	138	448	460	965	1,105
Total United States	33,841	40,715	4,346	4,683	21,580	22,264	59,767	67,662

[1] Figures for 1941 by States not yet available.

Some light fuel oil (No. 1 grade) is sold for range fuel and should be added to the kerosine to determine the total demand for range fuel. Light fuel oil reported as range oil in 1940 totaled 3,977,000 barrels compared with 3,220,000 in 1939. Total range-oil sales (kerosine plus No. 1 fuel oil) were 44,692,000 barrels in 1940 or 21 percent over 1939 requirements of 37,061,000.

Sales of range oil in the United States, 1938–40, by States [1]

[Thousands of barrels]

State	1938	1939	1940	
			Total	Percent of total
Massachusetts	9,959	10,814	13,419	30.0
New York	5,951	6,255	7,613	17.0
Connecticut	3,191	3,322	3,921	8.8
New Jersey	2,854	3,026	3,556	8.0
Rhode Island	2,127	2,172	2,619	5.9
Illinois	977	1,387	1,733	3.9
Maine	1,174	1,328	1,704	3.8
Pennsylvania	641	698	920	2.1
New Hampshire	701	781	898	2.0
Michigan	294	479	620	1.4
North Carolina	331	532	577	1.3
Vermont	448	468	560	1.3
Minnesota	296	403	555	1.2
Florida	325	439	542	1.2
Maryland	437	492	531	1.2
Wisconsin	280	446	516	1.1
Missouri	306	355	485	1.1
Ohio	290	320	398	.9
Iowa	204	291	335	.7
Texas	257	304	325	.7
Other States	2,664	2,749	2,865	6.4
Total United States	33,707	37,061	44,692	100.0

[1] Figures for 1941 by States not yet available.

There was an upward trend in kerosine prices in 1941. As an example, quotations for 41°–43° water-white kerosine at refineries in Oklahoma averaged 4.41 cents a gallon in 1941 compared with 4.04 cents in 1940. An average price of 4.12 cents per gallon in January, 1941, rose gradually during the spring months of the year and reached 4.56 cents in June and then remained at that level until the end of the year. The generally higher prices for kerosine in 1941 are reflected in the representative Chicago tank-wagon quotations, which increased from 10 cents a gallon in April to 10.5 cents in May. This top price did not hold, however, but settled to 10.3 cents in June, which quotation was in force until the end of 1941.

FUEL OIL

Increased refinery production, greater use of crude petroleum as fuel oil (transfers), a larger volume of imports, and curtailed exports were all factors that enabled oil companies to supply an increased domestic demand for fuel oil at fairly stable prices and to add slightly to stocks in 1941 compared with 1940. In other words, available supplies of fuel oil were ample in 1941 to satisfy an increased domestic demand and to maintain stocks without any appreciable advance in prices during a period when market quotations for most commodities were trending sharply upward.

In 1940 the domestic demand for fuel oil—501,014,000 barrels, a record up to that time—was exceeded by 11 percent in 1941, when heavy industries, such as railroads, gas and electric power plants, and manufacturing concerns, as well as the United States Navy, required substantially increased quantities of fuel oil. The weather in 1941 was comparatively mild in some important oil-heating areas compared with 1940, so that distillate fuel oils, mostly used for space heating, did not show a comparative increase in demand, as did that reported for residual grades or heavy fuel oils used for industrial purposes and for the Navy.

Salient statistics of fuel oil in the United States, 1940–41

[Thousands of barrels]

	1940			1941 [1]		
	Distillate fuel oil	Residual fuel oil	Total	Distillate fuel oil	Residual fuel oil	Total
Stocks at beginning of year:						
Refinery	26, 374	87, 774	114, 148	32, 082	83, 548	115, 630
Bulk terminal	7, 344	4, 516	11, 860	10, 858	5, 756	16, 614
Production	[2] 183, 304	[3] 316, 221	499, 525	[4] 189, 177	[5] 342, 367	531, 544
Transfers from crude oil to fuel oil:						
California	279	4, 070	4, 349	130	8, 874	9, 004
East of California	2, 297	3, 629	5, 926	2, 383	4, 095	6, 478
Imports:						
Bonded	257	11, 432	11, 689	(6)	(6)	(6)
Duty paid	3, 076	17, 934	21, 010	(6)	(6)	(6)
Exports	19, 140	16, 109	35, 249	(6)	(6)	(6)
Stocks at end of year						
Refinery	32, 082	83, 548	115, 630	38, 895	78, 054	116, 949
Bulk terminal	10, 858	5, 756	16, 614	11, 031	5, 141	16, 172
Indicated domestic demand.						
Class I railroads, purchases [7]	(6)	(6)	67, 131	(6)	(6)	83, 563
Public-utility power plants [8]	(6)	(6)	16, 772	(6)	(6)	20, 259
Bunker oil, foreign trade [9]	(6)	(6)	35, 037	(6)	(6)	(6)
All other demands	(6)	(6)	382, 074	(6)	(6)	(6)
	160, 851	340, 163	501, 014	(6)	(6)	(6)

[1] Subject to revision

[2] Includes 52,827,000 barrels produced by cracking.

[3] Includes 213,673,000 barrels produced by cracking.

[4] Includes 56,870,000 barrels produced by cracking.

[5] Includes 224,639,000 barrels produced by cracking.

[6] Figures not available.

[7] Interstate Commerce Commission; total includes Diesel fuel.

[8] Federal Power Commission.

[9] U. S. Department of Commerce.

The Bureau's annual survey covering the distribution of fuel-oil sales by States and principal uses is still incomplete for 1941, so little is known about the various demands, except for releases covering certain requirements by other Government agencies, and for estimates. Monthly statistical statements compiled by the Interstate Commerce Commission show that Class 1 railroads purchased 83,563,000 barrels of fuel oil (including 2,838,000 barrels of Diesel fuel) in 1941—a 25-percent gain over 1940 requirements of 67,131,000 (including 1,933,000 barrels of Diesel fuel). The Department of Commerce, did not release monthly export statistics, including bunker-oil loadings on vessels engaged in foreign trade after September 1941. The 9-month total for 1941 is 23,000,000 barrels of bunker fuel compared with 27,008,000 in the same period of 1940—a 15-percent decline—and it is believed that the total for all of 1941 will show a similar loss. No monthly

records covering oil bunkers lifted by vessels engaged in coastwise trade are available, but it is unlikely that this demand will show any gain or enough gain to counterbalance the loss in foreign bunker loadings, so that the total bunker-oil requirements in 1941 as revealed by the annual fuel-oil sales survey probably will show a total below the 1940 item of 74,803,000 barrels. Monthly releases of the Federal Power Commission indicate 20,259,000 barrels of fuel oil purchased by public-utility electric-power companies in 1941—a gain of 21 percent

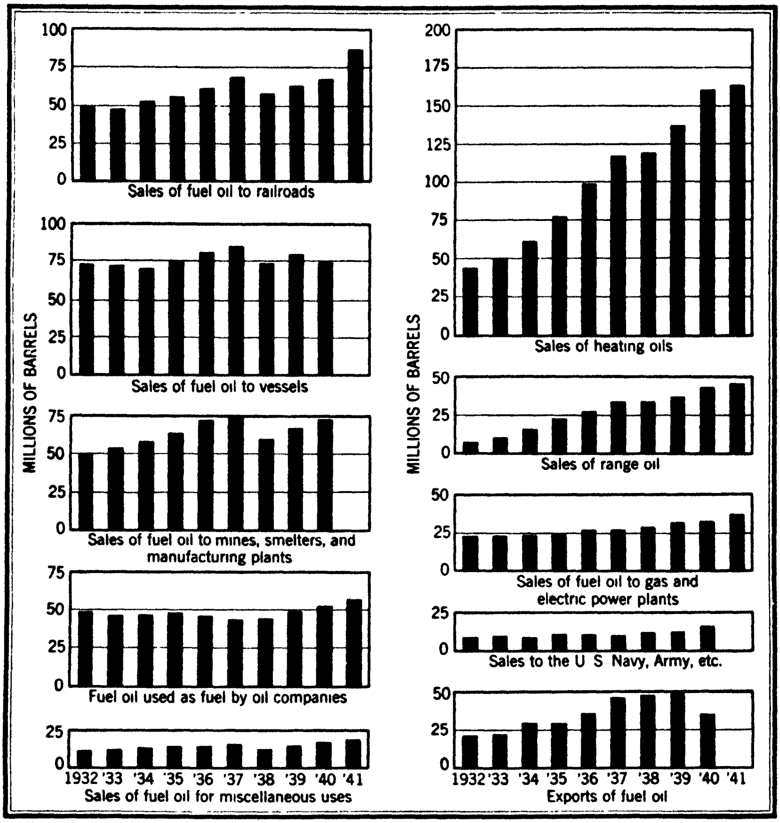

FIGURE 11.—Sales of fuel oil and range oil in the United States, 1932–41, by uses.

over the 1940 quantity, 16,772,000 barrels. When the fuel-oil purchases of the gas-manufacturing companies in 1941 compiled by the American Gas Association are added, it is believed that the fuel oil required by electric-power and gas-manufacturing industries will total approximately 39,000,000 barrels in 1941 compared with 32,795,000 in 1940. Estimates for other principal demands for fuel oil in 1941 are as follows: Smelters, mines, and manufacturing industries, 85,000,000 barrels; heating oils, 163,500,000; and oil-company fuel, 53,000,000.

Principal uses of fuel oil for the years 1932–41 are shown graphically in figure 11. The columns for 1932–40 are based upon totals derived from the Bureau's annual survey of fuel-oil sales, whereas those for 1941 are upon an estimated basis. Both distillate and residual fuel

Sales of fuel oil[1] *and of range oil in the United States, 1936–40, by uses*[2]

[Thousands of barrels]

Use	1936	1937	1938	1939	1940
Fuel oil:					
Railroads	61,727	69,458	57,829	63,235	68,098
Ships' bunkers (including tankers)	80,324	84,990	74,266	79,254	74,803
Gas and electric power plants	26,799	26,510	27,567	32,039	32,795
Smelters and mines	3,768	74,798	60,038	67,043	73,940
Manufacturing industries	67,558				
Heating oils	99,257	116,617	118,323	136,232	160,379
Fuel oil (No. 1) sold as range oil	(3)	2,747	2,902	3,220	3,977
U. S. Navy, Army transports, etc	9,241	9,135	11,756	12,472	17,183
Oil-company fuel	46,021	42,924	43,517	49,045	51,928
Miscellaneous uses	13,714	14,624	11,652	14,403	15,655
Total United States	408,409	441,803	407,850	456,943	498,758
Exports and shipments to noncontiguous Territories	34,883	45,433	47,561	49,505	35,249
Total	443,292	487,236	455,411	506,448	534,007
Range oil	27,292	32,259	33,707	37,061	44,692

[1] Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.
[2] Figures for 1941 not yet available.
[3] Figures not available.

Sales of distillate fuel oil[1] *in the United States, 1936–40, by uses*[2]

[Thousands of barrels]

Use	1936	1937	1938	1939	1940
Railroads	(3)	1,629	1,720	2,258	3,194
Ships' bunkers (including tankers)	(3)	13,494	13,088	14,108	13,249
Gas and electric power plants	(3)	2,989	3,685	4,131	4,561
Smelters, mines, and manufacturing industries	(3)	5,691	5,224	6,192	7,330
Heating oils	69,859	81,235	82,388	97,131	115,533
Fuel oil (No. 1) sold as range oil	(3)	2,747	2,902	3,220	3,977
U. S. Navy, Army transports, etc	(3)	343	782	1,313	1,402
Oil-company fuel	(3)	803	939	804	1,064
Miscellaneous uses	(3)	7,713	6,713	9,413	10,342
Total United States	102,515	116,644	117,441	138,570	160,652
Exports and shipments to noncontiguous Territories	20,448	30,129	29,641	32,020	19,140
Total	122,963	146,773	147,082	170,590	179,792

[1] Includes Diesel fuel.
[2] Figures for 1941 not yet available.
[3] Figures not available.

Sales of residual fuel oil[1] *in the United States, 1936–40, by uses*[2]

[Thousands of barrels]

Use	1936	1937	1938	1939	1940
Railroads	(3)	67,829	56,109	60,977	64,904
Ships' bunkers (including tankers)	(3)	71,496	61,178	65,146	61,554
Gas and electric power plants	(3)	23,521	23,882	27,908	28,234
Smelters, mines, and manufacturing industries	(3)	69,107	54,814	60,851	66,610
Heating oils	29,398	35,382	35,935	39,101	44,846
U. S. Navy, Army transports, etc	(3)	8,792	10,974	11,159	15,781
Oil-company fuel	(3)	42,121	42,578	48,241	50,864
Miscellaneous uses	(3)	6,911	4,939	4,990	5,313
Total United States	305,894	325,159	290,409	318,373	338,106
Exports and shipments to noncontiguous Territories	14,435	15,304	17,920	17,485	16,109
Total	320,329	340,463	308,329	335,858	354,215

[1] Includes Navy grade and crude oil burned as fuel
[2] Figures for 1941 not yet available.
[3] Figures not available.

oils are included. The range oil represented is all kerosine for the years 1932–36 and kerosine plus No. 1 fuel oil sold as range oil for subsequent years.

An export total for distillate and residual fuel oils for all of 1941 comparable with the 1940 quantity of 35,249,000 barrels is not available because of censorship regulations. However, exports of 22,196,000 barrels (including shipments to noncontiguous Territories of the United States) for the first 9 months of 1941 are 21 percent below the comparative total for 1940 of 28,043,000 barrels. The 11,400,000 barrels of distillate fuel oil reported as exported during the first three quarters of 1941 are 27 percent under the 15,579,000

Sales of fuel oil[1] *in the United States, 1936–40, by regions and States*[2]

[Thousands of barrels]

Region and State	1936	1937	1938	1939	1940
Pacific Coast:					
Washington	9,331	11,352	9,241	9,193	9,688
Oregon	9,918	10,879	9,308	8,752	11,089
California	65,895	70,952	59,316	69,790	71,516
Arizona	2,585	3,994	2,838	2,220	3,693
Nevada	2,791	3,790	2,690	3,109	3,418
Rocky Mountain:					
Idaho	223	520	420	483	565
Montana	1,652	1,802	1,451	1,947	2,077
Wyoming	1,549	1,799	1,654	1,853	2,012
Utah	404	508	471	485	603
Colorado	581	644	636	880	1,097
New Mexico	715	561	502	557	630
North Central:					
North Dakota	294	416	442	594	647
South Dakota	536	613	777	891	891
Minnesota	4,093	5,184	4,974	5,909	6,939
Nebraska	1,743	1,955	1,982	2,483	2,721
Iowa	1,873	2,261	2,325	2,969	3,449
Wisconsin	4,022	4,823	4,748	5,793	6,885
Illinois	18,351	20,964	19,930	22,561	26,182
Indiana	7,450	7,905	7,824	8,977	9,965
Michigan	9,000	9,847	8,228	10,119	11,967
Ohio	7,173	8,030	7,105	8,161	9,084
Kentucky	799	973	840	1,110	1,355
Tennessee	387	593	557	695	1,045
South Central:					
Missouri	7,605	8,980	8,502	9,339	10,404
Kansas	7,764	7,364	6,687	7,605	8,162
Texas	41,841	43,231	37,672	42,012	43,222
Oklahoma	9,461	9,083	8,269	8,112	8,544
Arkansas	2,876	2,658	2,056	2,156	2,562
Louisiana	11,614	12,350	10,871	11,318	11,810
Mississippi	593	796	529	631	619
Alabama	1,545	1,889	2,113	2,127	1,976
New England:					
Maine	2,328	2,490	2,150	2,645	3,040
New Hampshire	1,363	1,513	1,431	1,812	2,153
Vermont	458	566	539	675	803
Massachusetts	18,829	21,798	21,362	24,392	26,857
Rhode Island	6,894	7,283	6,839	7,893	8,839
Connecticut	7,047	7,822	7,482	9,064	10,675
Middle Atlantic:					
New York	42,215	43,428	43,389	48,154	54,520
New Jersey	41,458	44,232	42,862	48,087	49,578
Pennsylvania	26,098	26,320	26,213	27,285	29,269
Delaware	1,335	1,666	1,400	1,596	1,717
Maryland	8,423	9,549	9,003	10,218	12,286
District of Columbia	1,911	2,108	2,137	2,541	2,986
South Atlantic:					
Virginia	3,420	3,638	4,824	4,539	4,794
West Virginia	840	807	912	1,046	1,128
North Carolina	504	591	699	930	1,112
South Carolina	591	679	757	1,109	1,253
Georgia	1,744	1,787	2,022	2,288	2,418
Florida	8,287	8,810	8,871	9,838	10,513
Total United States	408,409	441,803	407,850	456,943	498,758

[1] Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.
[2] Figures for 1941 not yet available.

barrels shipped abroad in the same period of 1940. The foreign demand for American residual fuel oil also declined but to a lesser degree than for the lighter grades. Exports of heavy fuel oils decreased 13 percent from 12,464,000 barrels for the January–September interval of 1940 to 10,796,000 barrels in the same months of 1941. The fact that the export trade in distillate fuel oils, following the trend noted in 1940, declined to a greater degree than for the heavy grades is understandable, as under war conditions heavy fuel oil required for industrial and bunker fuel by foreign countries is given priority in shipping space over the lighter fuel oils, the use of which can be curtailed more easily.

Crude runs to stills increased by 9 percent in 1941; however, the production of fuel oil did not show a proportionate gain, as the yield for the fuel fractions declined from 38.6 percent in 1940 to 37.7 in 1941. Refiners reported the production of 531,544,000 barrels of fuel oil in 1941—a 6-percent increase over the quantity in 1940. Considering distillate and residual fuel oils separately, it is found that the lower percentage yield for fuel oil in 1941 was confined to the lighter grades (14.2 percent in 1940 and 13.4 in 1941); consequently the gain in production for this group—189,177,000 barrels in 1941 compared with 183,304,000 in 1940—was only 3 percent, although 9 percent more crude oil was run to stills. The principal factor that determined the lower yield for distillate fuel oil in 1941 was, it is believed, the less active market for domestic heating oils, owing to mild weather in some areas. Accelerated activities in 1941 by railroads, gas and electric-power plants, manufacturing establishments, the United States Navy, and the oil companies—all important users of heavy fuel oils—created a market demand that forced the oil refiners to maintain the yield of this fuel at the 1940 level (24.4-percent yield in 1940 and 24.3 in 1941); consequently, the 8-percent gain in production (342,367,000 barrels produced in 1941 compared with 316,221,000 in 1940) approximately paralleled the increase in crude runs to stills.

Refiners operating in districts east of California, lacking an incentive in 1941 to produce above-normal quantities of light heating oils, as was done in 1940, lowered the percentage yield for distillate fuel oils (14.2 percent in 1940 and 13.5 in 1941); as a result, the gain in production was only 4 percent in 1941 compared with an 18-percent increase in 1940. A review of the output of light fuel oils in the various refinery districts for 1941 compared with 1940 shows smaller percentage gains in 1941 in most areas of large volume production (East Coast, 31-percent gain in 1940 and 2 in 1941; Indiana, Illinois, Kentucky, etc., 26-percent gain in 1940 and 10 in 1941) and an actual decline in the Texas Gulf Coast area, the most important of all, from a 14-percent increase in 1940 to a 4-percent decline in production in 1941. The lower relative outputs in these districts in 1941 counterbalanced larger percentage gains reported for areas where the production of distillate fuel oil is less significant as a source of national supply. Comparative percentage increases in production of light fuel oil for two representative refinery districts in the latter grouping are as follows: Oklahoma, Kansas, and Missouri, 7-percent gain in 1940 and 16 in 1941; and Louisiana Gulf Coast, loss of 4 percent in 1940 contrasted with a 17-percent gain in 1941. The production of distillate fuel oil in California has declined in recent years from 30,023,000 barrels in 1939 to 28,418,000 in 1940 and to 27,803,000 in 1941, because

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Comparative analyses of statistics for distillate fuel oil in the United States, 1940–41, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers[1] East of Calif.		Transfers[1] California		Imports		Exports		Domestic demand		Stocks	
	1940	1941[2]	1940	1941[2]	1940	1941[2]	1940	1941[2]	1940	1941[2]	1940	1941[2]	1940	1941[2]	1940	1941[2]
By months:																
January	16,548	17,018	15.5	15.4	207	176		5		421	1,549	1,595	22,462	21,010	26,462	37,926
February	16,262	14,732	16.0	14.7	193	172	38	51	542	483	1,234	791	17,623	17,783	24,640	34,790
March	16,346	15,387	14.8	13.9	216	182	31	44	358	277	2,286	1,028	16,219	19,847	23,086	29,805
April	15,260	14,692	14.3	13.2	199	172	36	1	326	195	1,966	876	11,849	12,264	25,092	31,725
May	14,541	15,546	13.0	13.0	217	195	37	12	201	300	2,130	1,156	9,738	11,233	28,220	35,389
June	14,154	14,697	13.1	12.7	202	200	7	10	159	211	2,129	1,380	7,028	10,853	33,585	38,274
July	14,439	15,746	13.4	13.0	197	201	36	4	215	562	1,837	1,164	7,223	10,586	39,412	42,037
August	14,957	15,409	13.7	12.4	183	221	19		301	463	1,469	2,300	8,362	9,667	45,041	47,163
September	14,735	16,024	13.7	13.2	174	210	2		262	795	947	1,110	10,439	11,670	48,828	51,412
October	14,381	16,554	13.1	13.1	182	216	59	2	301	(³)	1,356	(³)	13,358	(³)	49,037	55,385
November	15,073	16,230	14.3	13.4	158	222	10		478	(³)	1,284	(³)	16,848	(³)	46,624	55,073
December	16,608	17,142	15.1	13.7	169	216	4	1	190	(³)	953	(³)	19,702	(³)	42,940	49,926
Total United States	183,304	189,177	14.2	13.4	2,297	2,383	279	130	3,333	(³)	19,140	(³)	160,851	(³)	42,940	49,926
By districts:																
East Coast	39,976	40,827	19.5	18.8					3,038		91				15,922	18,631
Appalachian	4,035	4,863	8.4	9.1							4				537	704
Indiana, Illinois, Kentucky, etc.	23,943	26,288	10.6	10.5	561	503					6				4,318	5,552
Oklahoma, Kansas, and Missouri	11,548	13,431	10.1	10.6	549	699									1,231	1,766
Texas Inland	2,257	2,430	3.7	3.6	644	718					23				288	301
Texas Gulf Coast	62,029	59,591	18.4	16.4	302	234			295	(³)	7,996	(³)	(⁴)	(⁴)	8,406	7,801
Louisiana Gulf Coast	7,407	8,631	16.4	15.9	123	97					472				1,593	1,798
Arkansas and Louisiana Inland	1,509	2,535	6.1	8.6	16	13									252	341
Rocky Mountain	2,182	2,778	7.2	8.3	102	119					32				328	319
California	28,418	27,803	14.1	13.0			279	130			10,516				10,065	12,713
Total United States	183,304	189,177	14.2	13.4	2,297	2,383	279	130	3,333	(³)	19,140	(³)	160,851	(³)	42,940	49,926

[1] Figures represent crude oil used as fuel on pipe lines. [2] Subject to revision. [3] Publication suspended. [4] Figures not available.

of a dwindling export trade and an approximately stationary domestic demand. However, increased runs to stills in 1941, even with a lower percentage yield (14.1 percent in 1940 and 13.0 in 1941), supplied light fuel oils adequate to satisfy all demands and to increase year-end stocks from 10,065,000 barrels in 1940 to 12,713,000 in 1941.

Oil companies operating refineries east of California produced 253,956,000 barrels of residual fuel oil in 1941, a gain of 9 percent over the 1940 quantity. The increase in residual output in 1941 was in direct proportion to the gain in crude runs in the area, and the percentage yield was not a factor, as it remained approximately 21 percent for both 1940 and 1941. All refinery districts east of California reported gains in residual-fuel-oil output except the East Coast, which declined for the second consecutive year. The fact that the production of heavy fuel oil on the Atlantic coast dropped by 6 percent from 53,252,000 barrels in 1940 to 50,113,000 in 1941 would not be expected under conditions prevailing in 1941, as the market demand was brisk and crude runs to stills increased by 6 percent; furthermore, the proportion of foreign crude (which has a high residual-fuel-oil content) processed was greater (22 percent of total runs in 1941 compared with 16 in 1940). However, as the percentage yield of heavy fuel oil for the East Coast district declined from 26.0 percent in 1940 to 23.1 in 1941, it is evident that refiners did not cater to the heavy-fuel-oil market beyond supplying contract customers but adjusted their runs to make more profitable products such as gasoline, the percentage yield of which increased. The expanding market for heavy fuel oil in 1941 is reflected in the increased production in all other refinery districts east of California. The Indiana, Illinois, Kentucky, etc., area reported 24 percent more residual-fuel-oil production in 1941 than in 1940, and districts supplying heavy fuel oil for tanker shipments to the East coast, namely, Texas Gulf, and Louisiana Gulf, stepped up their output 8 and 32 percent, respectively, in 1941 over 1940. California refiners, attempting to meet naval and industrial demands for residual fuel oil, increased production by 6 percent to 88,411,000 barrels in 1941 compared with a 3-percent gain in 1940 over 1939.

The fuel-oil supply in some areas is supplemented by burning non-gasoline-bearing crude petroleum directly as fuel.. Crudes thus used are termed "transfers" in the petroleum statistics of the Bureau of Mines and must be added to other supply items, such as production, imports, and draft on stocks in computing the indicated domestic demand for fuel oil. Light crudes used as fuel by pipe lines are credited to distillate fuel oils, and heavy crudes burned on leases and as industrial fuel are added to residual fuel oils. Transfers reported for 1941 totaled 15,482,000 barrels—a 51-percent gain over the corresponding item for 1940. All of the increase in transfers is found under residual fuel oil, and the quantity was up by 68 percent from 7,699,000 barrels in 1940 to 12,969,000 in 1941. Transfers added to the distillate-fuel-oil supply in 1941, 2,513,000 barrels, were slightly below the 1940 quantity—2,576,000 barrels. There was some gain in transfers to residual fuel oil in areas east of California (3,629,000 barrels in 1940 and 4,095,000 in 1941—a 13-percent increase), but most of it was reported from California, where, because of the pressure for naval and industrial fuel, the 1941 transfers of 8,874,000 barrels more than doubled the 1940 total of 4,070,000. The larger share of transfers classified as distillate fuel oil is confined to districts east of

Comparative analyses of statistics for residual fuel oil in the United States, 1940–41, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]: East of California		Transfers [1]: California		Imports		Exports		Domestic demand		Stocks	
	1940	1941 [2]	1940	1941 [2]	1940	1941 [2]	1940	1941 [2]	1940	1941 [2]	1940	1941 [2]	1940	1941 [2]	1940	1941 [2]
By months:																
January	28,082	27,880	26.4	25.2	325	299	314	495	1,882	2,211	1,139	1,002	32,473	32,817	89,281	85,092
February	24,680	25,944	24.3	25.8	307	277	364	560	3,044	2,616	769	975	27,123	30,612	89,784	82,902
March	26,870	27,677	24.4	24.9	307	294	382	366	4,406	4,210	964	1,170	31,434	32,645	89,351	81,634
April	25,372	26,748	23.7	24.0	361	327	337	193	1,930	2,406	1,532	1,378	26,887	30,792	88,932	79,138
May	26,551	27,994	23.8	23.4	321	360	424	561	1,327	2,143	1,379	981	26,341	29,997	89,835	79,218
June	25,469	27,882	23.5	24.0	299	281	413	789	2,446	2,083	1,959	1,267	25,355	29,038	91,148	79,948
July	25,248	28,624	23.4	23.6	270	277	343	667	1,397	1,085	1,387	954	23,990	28,887	93,029	80,760
August	26,451	29,836	24.3	24.0	370	323	269	507	2,384	2,611	1,815	1,600	26,267	30,169	94,421	82,268
September	25,504	28,118	23.7	23.1	276	394	432	1,758	1,709	4,217	1,552	1,469	25,843	31,534	94,947	83,752
October	27,944	30,871	25.5	24.3	216	394	218	1,086	2,891	(3)	1,366	(3)	30,192	(3)	94,658	84,960
November	26,125	29,666	24.8	24.4	287	452	241	982	2,395	(3)	1,334	(3)	29,980	(3)	92,392	83,730
December	27,925	31,127	25.5	24.9	290	417	333	910	3,555	(3)	913	(3)	34,278	(3)	89,304	83,195
Total United States	316,221	342,367	24.4	24.3	3,629	4,095	4,070	8,874	29,366	(3)	16,109	(3)	340,163	(3)	89,304	83,195
By districts:																
East Coast	53,252	50,113	26.0	23.1	-------	-------	-------	-------	(4)	(4)	-------	(3)	(4)	(4)	10,446	10,041
Appalachian	6,350	7,709	13.2	14.4	-------	-------	-------	-------			54				376	578
Indiana, Illinois, Kentucky, etc.	37,817	46,761	16.7	18.6	758	739	-------	-------			981				2,972	4,152
Oklahoma, Kansas, and Missouri	19,787	22,408	17.2	17.6	223	283	-------	-------			-------				2,122	2,046
Texas Inland	13,703	14,280	22.2	21.4	456	429	-------	-------			91				1,725	1,349
Texas Gulf Coast	78,850	84,806	23.3	23.3	781	747	-------	-------			3,412				8,486	8,710
Louisiana Gulf Coast	9,887	13,070	21.9	24.1	633	945	-------	-------			163				2,306	2,217
Arkansas and Louisiana Inland	6,279	7,180	25.3	24.5	497	622	-------	-------			-------				389	368
Rocky Mountain	6,603	7,629	21.9	22.7	281	330	-------	-------			-------				590	535
California	83,693	88,411	41.6	41.5	-------	-------	4,070	8,874			11,408				59,892	53,199
Total United States	316,221	342,367	24.4	24.3	3,629	4,095	4,070	8,874	29,366	(3)	16,109	(3)	340,163	(3)	89,304	83,195

[1] Represents quantities used on leases and for general industrial purposes.
[2] Subject to revision.
[3] Publication suspended.
[4] Figures not available.

California, where the total increased by 4 percent to 2,383,000 barrels in 1941. Only minor quantities of transfers of light crude to the distillate-fuel-oil account are found in the statistics for California, and the total has diminished from 616,000 barrels in 1939 to 279,000 barrels in 1940 and 130,000 in 1941.

No release of petroleum import statistics was made after September 1941, owing to censorship regulations. A total of 27,289,000 barrels of fuel oil was imported in the 9-month period of 1941—a 22-percent increase over the 22,304,000 barrels received in the same months of 1940. The distillate fuel oil brought into the country from January through September 1941—3,707,000 barrels—was 57 percent above receipts in the corresponding months of 1940, and residual fuel oil received from abroad in the same period of 1941 was 23,582,000 barrels—an 18-percent increase over the comparative 1940 total of 19,940,000.

Total fuel-oil stocks changed very little during 1941. Stocks of 133,121,000 barrels on December 31, 1941, were less than 1 percent above the 132,244,000 barrels in storage at the close of 1940. However, if distillate- and residual fuel-oil stocks are reviewed separately, it is noticed that the light-fuel-oil inventory of 49,926,000 barrels is 16 percent above the 42,940,000 held at the end of 1940, whereas the heavy fuel oil in storage declined by 7 percent from 89,304,000 barrels in 1940 to 83,195,000 in 1941. The export market for distillate fuel oil declined sharply in 1941; furthermore, the gain in domestic demand was not outstanding as in 1940, consequently there was a surplus to send to storage. Oil companies, however, even with greater supplies of residual fuel oil from increased production, imports, and transfers from crude, were forced to draw on stocks in 1941 to satisfy a very active domestic market and a fair export demand.

Distillate-fuel-oil stocks held east of California increased by 13 percent or from 32,875,000 barrels in 1940 to 37,213,000 in 1941. All refinery districts in this territory reported stock increases for distillate fuel oils in 1941 except the Texas Gulf—an important supply area for the East coast—and the Rocky Mountain area, where the volume of stocks is comparatively small. A large share of the light fuel oil used in the important East coast market is normally brought in by tankers from Gulf coast refineries; consequently, it is desirable to maintain large quantities in storage, especially during the heating season. Stocks in the East coast area increased by 17 percent—from 15,922,000 barrels in 1940 to 18,631,000 in 1941—even though numerous tankers were diverted for war purposes. Large percentage gains in distillate-fuel-oil stocks in 1941, reported for refinery districts where volumes held are comparatively important, were as follows: Indiana, Illinois, Kentucky, etc., 29 percent; Oklahoma, Kansas, and Missouri, 44 percent; and Louisiana Gulf Coast, 13 percent. Oil companies operating in the California district, faced with a static domestic demand and a declining export trade in distillate fuel oils in 1941, sent large enough quantities to storage to increase the 1941 total to 12,713,000 barrels—a 26-percent increase over the 1940 year-end inventory of 10,065,000.

The 7-percent decline in total residual-fuel-oil stocks held at the end of 1941 compared with 1940 was largely associated with an 11-percent decline in important quantities stored in California, as inventories for

the refinery districts east of California netted a 2-percent increase from 29,412,000 barrels in 1940 to 29,996,000 at the close of 1941. Six districts out of nine in the territory east of California showed residual-fuel-oil stock declines in 1941, so that the small net increase for the area as a whole is traceable to a 40-percent gain in the Indiana, Illinois, Kentucky, etc., district (2,972,000 barrels in 1940 and 4,152,000 in 1941), where production of residual fuel oil increased 24 percent in 1941, and to a 3-percent stock expansion in the Texas Gulf (8,486,000 barrels in 1940 and 8,710,000 in 1941). Heavy-fuel-oil stocks held in the Appalachian refinery district also rose by 54 percent in 1941, but the quantities involved are small. There was a fair increase (6 percent) in residual-fuel-oil production in California during 1941 plus greatly augmented (118-percent gain) transfers of non-gasoline-bearing crude to the heavy-fuel-oil account. However, the larger supply did not meet increased demands; consequently a heavy draft on stocks reduced the inventory from 59,892,000 barrels in 1940 to 53,199,000 at the end of 1941.

Beginning in July 1941, tanker movements from Gulf ports to the East coast were counted only when the cargoes were intended primarily for domestic consumption; that is, fuel oil in this coastal movement earmarked for Lend-Lease or defense purposes was excluded. The tanker shipment of fuel oils from Gulf refinery districts to the Atlantic seaboard, even with the limitation as to ultimate domestic use invoked in the second half of 1941, increased by 6 percent from 111,775,000 barrels in 1940 to 118,543,000 in 1941. The gain in this trade, however, was limited to residual fuel oils, the total of which increased by 13 percent from 67,346,000 barrels in 1940 to 75,923,000 in 1941. The lack of a strong market for distillate fuel oils on the Atlantic coast in 1941, coupled with the difficulty of securing tankers, is shown in the movement of light fuel oils from the Gulf to the East coast, which declined from 44,429,000 barrels in 1940 to 42,620,000 in 1941.

A strong market for residual fuel oils in California in 1941 and the difficulty in obtaining boats were factors in the sharp decline reported in the tanker movement of fuel oils from California to Gulf and East coast points. Light fuel oils in this movement dropped from 721,000 barrels in 1940 to 203,000 in 1941, and for heavy grades the quantity declined from 566,000 barrels in 1940 to a negligible item of 23,000 barrels in 1941.

Small quantities of fuel oil moved out of the California marketing area (California, Oregon, Washington, Arizona, and Nevada) by railroad tank cars and trucks to adjoining States. Shipments of distillate fuel oil in this overland movement increased from 282,000 barrels in 1940 to 382,000 in 1941, but heavy fuel oils declined from 198,000 barrels in 1940 to 130,000 in 1941.

Tanker rates for both "clean" boats (carrying light petroleum products) and "dirty" boats (carrying crude and heavy fuel oils) on the Gulf to North Atlantic route not east of New York averaged higher in 1941 than in 1940. The average rate paid to tankers for moving No. 2 heating oil on this run advanced from 52.6 cents a barrel in 1940 to 55.7 in 1941 and was double the 1939 average of 27.8 cents. The 1941 average of 56.9 cents a barrel for transporting heavy residual fuel oil over the same route was 10 cents above the 1940 average of 46.9 and more than twice the 1939 average of 25.8

cents. Incidentally the 1941 average rate for heavy fuel oil from the Gulf coast to North Atlantic points was slightly above the average quotation for No. 2 fuel oil in "clean" boats, which is unusual, as "dirty" boats in which crude oil and residual fuel oil are carried normally receive a lower rate per barrel.

The demand for "clean" tankers and their scarcity, owing to their diversion to other routes at the request of the Government, forced the Gulf coast-North Atlantic freight rate on light fuel oil up to 80 cents a barrel in December 1940. This high charge did not hold, however, and the quotation declined to 62 cents a barrel on January 6, 1941, and to 60 cents on January 20. The tanker rate, with the return of some boats to oil-company control and the larger share of the heating-oil load satisfied, declined to 42 cents on February 10 and to 40 cents on February 17, the lowest rate for the year; this quotation was double the low of 20 cents for 1940, in August of that year. A further shortage of tankers and the general uncertainty in shipping conditions started a rise in quotations in March 1941 to a month-end rate of 62 cents a barrel. The freight cost then declined to 57 cents a barrel on April 14 and remained at that level through November, after which month no rates were quoted.

The 1940 year-end rate of 66 cents a barrel for "dirty" boats used in transporting heavy residual fuel oil from the Gulf coast to North Atlantic points remained in force until February 17, 1941, when it dropped to 50 cents and then to 45 cents on February 24, the lowest quotation of the year and a rate well above the 20-cent-a-barrel low of 1940, in August-September of that year. The continued demand for tankers forced the freight quotation for residual fuel oil to 50 cents a barrel on March 17, to 55 cents on March 24, and finally to 57 cents on April 7, 1941, where it remained through November. No tanker rates were posted in December 1941.

The average price of representative fuel oils in 1941 differed only slightly from 1940 quotations. Increased production, a greater use of crude petroleum as fuel oil, a larger volume of imports, and a lower export demand were all factors which enabled oil companies to supply an active domestic market without applying the brake of higher prices. Two quotations of the several representative fuel-oil prices under review showed slight advances in 1941—the price of No. 2 straw fuel oil (widely used for domestic heating) at refineries in Oklahoma increased from an average of 3.47 cents a gallon in 1940 to 3.69 in 1941, and Diesel fuel for ships' bunkers at New York harbor was quoted at an average of $1.99 a barrel in 1941 compared with $1.98 in 1940. The average prices for other representative fuel oils remained unchanged or actually declined in 1941. Bunker C fuel oil for ships loading in New York averaged $1.34 a barrel for both 1940 and 1941, even though an average increase of 10 cents a barrel in the Gulf coast-North Atlantic tanker rate had to be absorbed in 1941. The price of Diesel fuel for ships' bunkers at Los Angeles also remained at an average of $1.40 a barrel for 1940 and 1941. The average quotation for several fuel oils declined in 1941 compared with 1940 as follows: Bunker C at Gulf ports 90 cents a barrel in 1940 and 87 cents in 1941; Bunker C at Los Angeles, 82 cents a barrel in 1940 and 80 cents in 1941; and Diesel fuel for ships' bunkers at Gulf ports, $1.64 a barrel average in 1940 and $1.56 in 1941.

Retail prices for various fuels are compiled by the Bureau of Labor Statistics, United States Department of Labor. Monthly releases of that Bureau show that No. 2 heating oil at Chicago averaged 7.73 cents a gallon for the first 3 months of 1941 or the same price as in the first quarter and in December 1940. The quotation declined to 7.47 cents a gallon in April 1941, and this price held until August, when a low for the year of 7.40 cents was reported compared with a low of 7.30 cents in the second and third quarters of 1940. The fall

Monthly average prices of kerosine and fuel oils in the United States, 1940–41 [1]

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1940													
41°–43° gravity w. w. kerosine at refiners, Oklahoma cents per gallon	3.95	4 00	4 02	4.09	4.13	4.08	4.06	4 06	4.06	4.06	3.94	3.99	4.04
Kerosine, tank-wagon at Chicago cents per gallon	10.00	10 00	10.00	10 00	10.00	10.00	10.00	10.00	10 00	10 00	10.00	10.00	10.00
No. 2 straw fuel oil at refineries, Oklahoma cents per gallon	3.43	3.56	3.46	3.44	3.44	3.44	3.44	3.44	3.44	3.48	3.50	3.54	3.47
Bunker C for ships:													
New York dollars per barrel	1.42	1.50	1 50	1.49	1.48	1.35	1.31	1 20	1 20	1 20	1.20	1 20	1.34
Gulf coast do	.95	.97	.97	.95	.91	.88	.86	.85	.85	.85	.85	.85	.90
California do	.82	.88	.88	.88	86	.83	.85	.88	.85	.72	.68	.70	.82
Diesel oil for ships:													
New York dollars per barrel	2 15	2 15	2.21	2 28	2 18	2 00	1.85	1 78	1.70	1 70	1.82	1 98	1.98
Gulf coast do	1 70	1 70	1.70	1 70	1 68	1.60	1 60	1 60	1 60	1 60	1.60	1.60	1.64
California do	1.40	1.40	1 40	1.40	1 40	1 40	1.40	1 40	1 40	1 40	1 40	1 40	1.40
1941													
41°–43° gravity w. w. kerosine at refineries, Oklahoma cents per gallon	4.12	4 13	4 13	4.24	4.42	4.56	4.56	4 56	4.56	4.56	4 56	4.56	4.41
Kerosine, tank-wagon at Chicago cents per gallon	10 00	10 00	10 00	10 00	10.50	10.30	10 30	10 30	10.30	10 30	10.30	10.30	10.20
No. 2 straw fuel oil at refineries, Oklahoma cents per gallon	3.68	3.57	3.50	3.50	3.53	3.63	3.63	3.81	3.81	3.87	3.88	3.88	3.69
Bunker C for ships:													
New York dollars per barrel	1.25	1.25	1 25	1.28	1.30	1.34	1 38	1 39	1.43	1 43	1 43	1.41	1.34
Gulf coast do	.83	.83	.83	.86	.88	.88	.90	.90	.90	.90	.90	.90	.87
California do	.63	.66	.69	.69	.82	.88	.88	.88	.88	.88	.88	.88	.80
Diesel oil for ships:													
New York dollars per barrel	1 96	1 76	1 67	1 86	1 99	2.00	2 00	2 07	2 15	2 15	2.15	2.15	1.99
Gulf coast do	1.60	1.56	1 43	1.46	1.48	1.52	1.55	1.55	1.55	1 62	1.73	1.73	1.56
California do	1.40	1.40	1.40	1 40	1.41	1 41	1 40	1 40	1 40	1.40	1.40	1.40	1.40

[1] Platt's Oil Price Handbook.

heating demand forced up the price to 7.61 cents a gallon in September 1941 and to 7.65 cents in the final quarter—a quotation slightly above the average of 7.54 cents for the fourth quarter of 1940. The retail price of No. 2 heating oil in New York was 6.94 cents a gallon in January 1941, or the same as in the final month of 1940. The consumer price dropped to 6.45 cents a gallon in February 1941 and to 6.28 cents in March for the low of the year, a quotation just above the low of 1940—6.12 cents—reported for September and October of that year. Summer stocking by consumers forced up the price to 6.43 cents a gallon in April 1941 and then by gradual increases to 7.30 cents in October—the highest quotation of the year compared

with a top price in 1940 of 7.14 cents in March. There was a slight decline in the New York retail price of No. 2 fuel oil to 7.27 cents a gallon in November 1941.

LUBRICATING OIL

Domestic demand for lubricating oil increased more than 20 percent in 1941 over the 1940 record. Production increased 2,774,000 barrels to 39,539,000 barrels, exports declined, and 640,000 barrels were withdrawn from stocks. The greatest gain in demand for lubricating oil was in that used for industrial purposes, which increased 34 percent, although there was also a substantial gain in automotive consumption.

Foremost in the increased use of industrial types is cutting oil. Transformer oil has also had a large gain in demand; and the use of hydraulic oil, though not so important in the total, has expanded rapidly. A number of installations formerly operated by cable are now being controlled hydraulically. Many operations, for example, on large planes now under construction will have this type of control. The expanding demand for lubricants for aviation and for tanks, included under industrial uses, as well as for heavy-duty trucks, has caused requirements to change from a large proportion of neutrals to a larger proportion of bright stock. Whereas refiners were only recently considering means of cracking the bright stock to get a larger proportion of neutrals, they are now having difficulty supplying the demand for it.

Comparative analyses of statistics for lubricating oil in the United States, 1940–41, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands barrels)		Stocks (thousands of barrels)	
	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]
By months:								
January	3,308	2,943	3.1	2.7	2,054	2,367	7,328	8,809
February	3,108	2,522	3.1	2.5	1,522	1,798	7,825	8,790
March	3,335	2,813	3.0	2.5	1,899	2,263	8,084	8,637
April	3,280	3,213	3.1	2.9	2,144	2,712	8,065	8,363
May	3,341	3,322	3.0	2.8	2,069	2,732	8,170	7,835
June	3,212	3,520	3.0	3.0	2,151	3,171	8,161	7,353
July	3,024	3,563	2.8	2.9	1,871	3,074	8,573	7,107
August	2,635	3,561	2.4	2.9	2,024	2,562	8,457	7,206
September	2,682	3,427	2.5	2.8	2,150	2,638	8,596	7,415
October	2,954	3,494	2.7	2.8	2,482	(2)	8,464	7,487
November	3,021	3,607	2.9	3.0	2,449	(2)	8,365	7,752
December	2,865	3,554	2.6	2.8	1,875	(2)	8,767	8,127
Total United States	36,765	39,539	2.8	2.8	24,690	(2)	8,767	8,127
By districts:								
East Coast	8,550	8,608	4.2	4.0	(3)	(3)	2,711	2,406
Appalachian	6,016	6,414	12.5	12.0			949	745
Indiana, Illinois, Kentucky, etc.	3,545	4,307	1.6	1.7			697	747
Oklahoma, Kansas, and Missouri	3,447	3,976	3.0	3.1			672	749
Texas Inland	238	358	.4	.5			58	126
Texas Gulf Coast	9,142	9,677	2.7	2.7			1,977	1,588
Louisiana Gulf Coast	1,630	2,093	3.6	3.9			236	255
Arkansas and Louisiana Inland	680	679	2.7	2.3			101	49
Rocky Mountain	179	187	.6	.5			102	108
California	3,338	3,240	1.7	1.5			1,264	1,359
Total United States	36,765	39,539	2.8	2.8	24,690	(2)	8,767	8,127

[1] Subject to revision. [2] Publication suspended. [3] Figures not available.

Automotive consumption of lubricants in the United States, 1940–41

[Thousands of barrels]

Use	Passenger cars		Trucks		Busses	
	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]
Crankcase oil	7,800	8,423	2,113	2,176	181	190
Transmission oils	590	667	214	230	32	35
Total lubricating oils	8,390	9,090	2,327	2,406	213	225
Chassis greases	531	600	107	115	9	10
Total lubricants	8,921	9,690	2,434	2,521	222	235

[1] Subject to revision.

Domestic demand for lubricating oil, 1937–41

[Thousands of barrels]

Year	Automotive				Industrial	Total demand
	Passenger cars [1]	Trucks [1]	Busses [1]	Total		
1937	8,503	2,305	197	11,005	12,318	23,323
1938	8,195	2,185	199	10,579	10,654	21,233
1939	8,245	2,298	205	10,748	12,965	23,713
1940 [1]	8,390	2,327	213	10,930	13,760	24,690
1941 [2]	9,090	2,406	225	11,721	([3])	([3])

[1] Revised. [2] Subject to revision. [3] Publication suspended.

A decreasing ratio of lubricating oil used by motor vehicles in proportion to gasoline has retarded the growth in consumption of lubricants for several years. Prominent among the reasons for this are the practice among motorists of changing oil less frequently and the reclamation of used lubricating oil.

The reclaiming of lubricating oil has grown considerably in the last decade. Many fleet owners operate oil purifiers that neutralize acids and extract water and gasoline by heating the oil with a clay and then filtering it. Used oils and crankcase drainings are also collected from industrial plants, service stations, and garages, particularly in the northeastern part of the United States. Formerly a charge was made for collecting the oil, and it was used as fuel. Later, with the advent of renovation of used oil, collection was made gratis, and in recent years a cent or two a gallon has been paid for the oil. Renovating plants range from small ones that can perform only the simpler reclaiming operations of neutralizing the acids and extracting gasoline, water, and carbonaceous and other foreign solids to large refineries operating stills, treatment agitators, settling tanks, and complete modern filter plants. In the small plants the waste lubricants that are contaminated with heavy oils and greases can be prepared only for use as fuel.

Although the collection and reclamation of crankcase drainings are quite complete in densely populated parts of the country, there are many large towns and cities where their disposal is less economic—some instances even where this waste oil is run into the sewer or dumped in pits or on vacant lots. Other applications include the lubrication of molds for cement, clay products, etc.; rustproofing and

lubricating farming and mining equipment; and use as an insecticide for farm stock and buildings, as fuel, for laying dust on roads, driveways, and parking areas, for mosquito control, and in crankcases of older automobiles. An effort should be made during the war, particularly during transportation difficulties, to make the most economical use of crankcase drainings possible.

Lubricating-oil production totaled 39,539,000 barrels in 1941 compared with 36,765,000 barrels in 1940. The Texas Gulf Coast district maintained the lead, producing 9,677,000 barrels or 24.5 percent of the total. The East Coast district followed with 8,608,000 barrels or 21.8 percent, and the Appalachian was third with 6,414,000 barrels or 16.2 percent.

The decline of 640,000 barrels in stocks of lubricating oil—from 8,767,000 barrels on December 31, 1940, to 8,127,000 on December 31, 1941—left them higher than in any previous year since 1932 except 1940. The principal declines were in the Texas Gulf Coast, East Coast, and the Appalachian districts, where they dropped 389,000, 305,000, and 204,000 barrels, respectively. California had the largest gain—from 1,264,000 barrels to 1,359,000.

Average monthly refinery prices of 5 selected grades of lubricating oil in the United States, 1940–41, in cents per gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av.
1940													
Oklahoma:													
200 viscosity, No. 3 color, neutral	14.00	13.90	13.38	13.25	12 80	11.56	10.78	10.10	9.75	9.75	9.75	9.75	11.56
150–160 viscosity at 210°, bright stock, 10–25 pour test	23.75	23.75	22.77	22.25	19 70	17 36	15.76	14 44	14.25	14.25	14.25	14 20	18.06
Pennsylvania													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	31 64	27.95	26 55	25.00	22.20	21 70	21 00	21.25	21.50	21.13	21.25	21 50	23.56
600 steam-refined, cylinder stock, filterable	18.11	15.58	14.08	13.20	12.32	11.20	8 73	8.00	7.65	7.42	7 35	7.61	10.94
Gulf Coast 500 viscosity, No. 2½–3½ color, neutral	9 13	9.13	9 13	9.08	9 00	9 00	8 95	8.63	8.75	8.56	8.50	8.50	8.86
1941													
Oklahoma·													
200 viscosity, No. 3 color, neutral	9.75	9.75	9.75	9.95	10.45	11 21	12.26	13.38	14.56	15 23	15 25	15.25	12.23
150–160 viscosity at 210°, bright stock, 10–25 pour test	13.84	14.25	14.25	14.68	15 83	18 21	20.13	21.08	22 17	22 75	22.75	22.75	18.56
Pennsylvania·													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	21.50	21.50	22.26	24.20	27 95	32.07	35.52	35.07	33.98	33 00	33.00	33.00	29.42
600 steam-refined, cylinder stock, filterable	8.05	8 96	9 40	10.09	11.04	12.42	13 60	14.71	15.33	16 00	15.50	15 50	12.55
Gulf Coast· 500 viscosity, No. 2½–3½ color, neutral	8.50	8.50	8.50	8.50	8 94	9.00	9.63	10.00	10.00	10 00	10.00	10.00	9.30

[1] National Petroleum News.

A request of the Office of Price Administration and Civilian Supply on August 4, fixing the maximum price of Pennsylvania Grade neutral oil at 33 cents, retarded the rise in lubricating-oil prices. This grade had been quoted as high as 40 cents a gallon, and the average for July was 35.52 cents, or 14 cents higher than the price at the beginning of the year. The price of Pennsylvania steam-refined cylinder stock, after reaching an average of 16 cents during October, receded to 15.5 cents for the rest of the year, which was double the price prevailing at the close of 1940. Prices for Oklahoma neutral and

bright stock did not reach their high levels until November, when the Price Administrator established ceilings for refined products. The former stabilized at 15.25 cents and the latter at 22.75 cents, representing increases of 5½ and 9 cents, respectively, during the year.

OTHER PRODUCTS

WAX

The total demand for paraffin wax rose from 546,718,000 pounds in 1940 to 743,480,000 in 1941, and the domestic demand increased almost 50 percent. Stocks dropped from 125,272,000 pounds to 74,814,000, the lowest since 1933.

Production increased from 513,240,000 pounds in 1940 to 676,480,000 in 1941. The Louisiana Gulf Coast district made the greatest gain, as the production of 89,320,000 pounds more than tripled the 28,000,000 pounds produced in 1940; the increase in Texas Gulf Coast district—from 76,440,000 pounds to 122,640,000—came next. The Indiana, Illinois, Kentucky, etc., district was the only one where production declined. The East Coast district maintained first place, producing 233,520,000 pounds.

Prices for 122°–124° white crude scale wax, after receding slightly early in the year to a low of 2.5 cents a pound, began advancing until they reached a peak of 6.25 cents in September. The Price Administrator, however, set a maximum price of 4.25 cents effective December 1, which prevailed during the last month of the year.

Comparative analyses of statistics for wax in the United States, 1940–41, by months and districts

[Thousands of pounds]

Month and district	Production		Domestic demand		Stocks			
					Crude scale		Refined	
	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]
By months:								
January	48,440	45,080	35,187	37,276	54,575	77,441	20,000	42,586
February	49,560	38,920	17,028	31,613	57,017	75,762	25,614	43,388
March	47,320	51,240	19,342	34,804	62,801	75,767	27,572	46,120
April	42,560	56,280	29,537	52,151	66,425	71,928	30,485	44,168
May	44,240	57,400	24,264	40,897	71,415	76,052	31,874	42,404
June	39,760	54,600	21,798	46,975	73,742	72,457	36,604	38,024
July	37,520	55,440	30,333	47,803	74,750	70,640	39,228	30,794
August	33,320	54,320	41,897	54,027	71,193	59,465	41,166	26,359
September	39,760	66,360	37,988	53,831	68,544	57,676	41,484	21,782
October	43,120	67,760	37,350	(2)	68,940	54,773	44,887	20,694
November	43,960	68,880	30,662	(2)	72,089	51,657	48,123	24,756
December	43,680	60,200	31,538	(2)	77,428	46,841	47,844	27,973
Total United States	513,240	676,480	356,924	(2)	77,428	46,841	47,844	27,973
By districts:								
East Coast	196,000	233,520			26,418	10,522	23,664	8,604
Appalachian	100,240	112,000			14,974	10,118	2,800	3,062
Indiana, Illinois, Kentucky	54,600	49,280			24,135	19,409	2,523	2,086
Oklahoma, Kansas, and Missouri	39,480	51,240	(3)	(3)	3,898	2,869	1,216	1,930
Texas Inland	1,400	1,400			126	----	----	----
Texas Gulf Coast	76,440	122,640			1,103	1,479	14,813	7,765
Louisiana Gulf Coast	28,000	89,320			302	248	1,192	3,179
Rocky Mountain	17,080	17,080			6,472	2,196	1,636	1,347
Total United States	513,240	676,480	356,924	(2)	77,428	46,841	47,844	27,973

[1] Subject to revision. [2] Publication suspended. [3] Figures not available.

Average monthly refinery price of 122°–124° white crude scale wax at Pennsylvania refineries, 1937–41, in cents per pound [1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1937	2.53	2.65	2.68	2.69	2.73	2.88	2.95	2.96	2.95	2.98	2.98	2.91	2.82
1938	2.52	2.13	2.02	1.93	1.93	2.17	2.29	2.37	2.40	2.39	2.33	2.32	2.23
1939	2.39	2.49	2.60	2.73	2.96	3.00	2.95	2.88	3.47	4.95	6.56	6.75	3.64
1940	6.21	5.57	5.32	4.79	4.69	4.19	2.93	2.21	2.51	2.81	2.93	2.87	3.92
1941	2.73	2.63	2.86	3.28	3.85	4.96	5.13	5.26	5.96	6.25	6.21	4.25	4.45

[1] National Petroleum News.

COKE

The total demand for petroleum coke was 1,907,800 tons in 1941 compared with 1,705,600 in 1940. Stocks dropped to a record year-end low of 228,000 tons compared with 1,511,600 at the end of 1931. The Indiana, Illinois, Kentucky, etc., district furnished more than half of the 1,648,800 tons produced.

Comparative analyses of statistics for petroleum coke in the United States, 1940–41, by months and districts

	Production (thousands of short tons)		Yield (percent)		Domestic demand (thousands of short tons)		Stocks (thousands of short tons)	
	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]
By months:								
January	116.4	125.8	0.5	0.6	137.8	195.5	628.0	406.0
February	131.2	102.6	.6	.5	125.7	118.6	628.0	375.0
March	129.6	125.0	.6	.6	123.8	114.5	624.0	375.0
April	139.2	128.2	.7	.6	72.7	86.2	663.0	400.0
May	152.4	140.0	.7	.6	111.4	119.5	681.0	385.0
June	148.6	144.4	.7	.6	101.9	116.0	697.0	382.0
July	121.4	134.2	.5	.6	119.8	126.7	678.0	367.0
August	122.6	137.0	.6	.5	117.4	102.7	647.0	372.0
September	119.2	157.8	.6	.6	122.3	147.2	617.0	370.0
October	131.4	153.6	.6	.6	134.0	(2)	581.0	362.0
November	88.4	149.4	.4	.6	99.6	(2)	527.0	390.0
December	126.2	150.8	.6	.6	140.5	(2)	487.0	228.0
Total United States	1,526.6	1,648.8	.6	.6	1,406.9	(2)	487.0	228.0
By districts:								
East Coast	5.2	4.4	(3)	(3)	(4)	(4)	2.0	2.0
Appalachian	25.6	26.0	.3	.2			17.0	9.0
Indiana, Illinois, Kentucky, etc.	943.6	894.0	2.1	1.8			107.0	64.0
Oklahoma, Kansas, and Missouri	163.0	181.4	.7	7			7.0	17.0
Texas Inland	76.8	119.4	.6	.9			31.0	51.0
Texas Gulf Coast	149.2	185.0	.2	.3			104.0	40.0
Louisiana Gulf Coast	------	------	------	------			1.0	1.0
Rocky Mountain	44.0	49.4	.7	.7			35.0	35.0
California	119.2	189.2	.3	.4			183.0	9.0
Total United States	1,526.6	1,648.8	.6	.6	1,403.5	(2)	487.0	228.0

[1] Subject to revision.
[2] Publication suspended.
[3] Less than 0.1 percent.
[4] Figures not available.

ASPHALT AND ROAD OIL

The total demand for asphalt in 1941—about 6,700,000 tons—represented a 24-percent gain over the 1940 demand of 5,420,400 tons. Production increased 1,210,900 tons to 6,557,600, but stocks decreased 10,000 tons to 604,000.

Road-oil production increased 1,378,000 barrels to 9,149,000, whereas domestic demand increased 1,131,000 barrels to 8,980,000. Stocks, which gained the 169,000 barrels difference, amounted to 793,000 barrels on December 31.

Detailed statistics on asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

STILL GAS

Production of still gas in 1941 amounted to 293,565 million cubic feet (equivalent 77,254,000 barrels) compared with 273,420 million cubic feet produced in 1940. Of the latter, 252,914 million cubic feet (92.5 percent) were used as refinery fuel, which, in terms of British thermal units, constituted more than half of all the heat utilized at refineries.

The Texas Gulf Coast district continued to lead in the production of still gas in 1941, with the Indiana, Illinois, Kentucky, etc., and East Coast districts following in order.

Production of still gas in the United States, 1939–41, by districts

District	1939		1940		1941 [1]	
	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels
East Coast	33,684	8,864	38,804	10,779	44,536	11,720
Appalachian	8,698	2,289	10,080	2,800	10,625	2,796
Indiana, Illinois, Kentucky, etc.	52,321	13,769	56,110	15,586	59,466	15,649
Oklahoma, Kansas, and Missouri	23,038	6,063	22,698	6,305	24,707	6,502
Texas Inland	13,650	3,592	15,181	4,217	15,572	4,098
Texas Gulf Coast	86,244	22,696	87,156	24,210	93,104	24,501
Louisiana Gulf Coast	8,528	2,244	9,616	2,671	7,741	2,037
Arkansas and Louisiana Inland	3,365	885	3,067	852	3,511	924
Rocky Mountain	5,590	1,471	5,663	1,573	6,198	1,631
California	26,242	6,906	25,045	6,957	28,105	7,396
Total United States	261,360	68,779	273,420	75,950	293,565	77,254

[1] Subject to revision.

MISCELLANEOUS PRODUCTS

The output of miscellaneous oils in 1941 amounted to 3,986,000 barrels compared with 3,202,000 in 1940. The total demand increased from 3,119,000 barrels in 1940 to 3,961,000 in 1941.

Detailed data, by products, for 1940, the latest year available, indicate that almost all of the gain of 843,000 barrels in production for that year is attributable to a gain in production of liquefied petroleum gas, which increased 761,000 barrels. The refinery production of liquefied petroleum gas (1,719,000 barrels) constituted 23 percent of the sales and exports of that product in 1940 and is almost as large as the total sales in 1935.

Production of miscellaneous oils in the United States, 1939–40, by districts and classes[1]

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Liquefied petroleum gas	Other	Total
1939							
East Coast	115		159	2	416	131	823
Appalachian	190					43	233
Indiana, Illinois, Kentucky, etc	39			18	446	53	556
Oklahoma, Kansas, and Missouri	41	64				24	129
Texas Inland		64			5	13	82
Texas Gulf Coast	9			48	57	33	147
Louisiana Gulf Coast					27	76	103
Arkansas and Louisiana Inland						1	1
Rocky Mountain		2		4	7	61	74
California		42	33	81		55	211
Total United States	394	172	192	153	958	490	2,359
1940							
East Coast	94		148		837	117	1,196
Appalachian	230	8		4		52	294
Indiana, Illinois, Kentucky, etc	39			43	725	43	850
Oklahoma, Kansas, and Missouri	35	43			40	15	133
Texas Inland		51			29	60	140
Texas Gulf Coast	11			65	36	171	283
Louisiana Gulf Coast	20				29	51	100
Rocky Mountain	1				23	4	28
California		28	37	62		51	178
Total United States	430	130	185	174	1,719	564	3,202

[1] Figures for 1941 in detail not yet available.

WORLD PRODUCTION [2]

Although war was being waged over extensive areas of the earth, the world production of crude petroleum increased 4 percent from 1940 to 1941, if numerous unofficial statistics and estimates can be considered reliable. The increase was due largely to the 4-percent augmented yield in the United States, which comprised 63 percent of the world total both in 1940 and in 1941. Venezuela and U. S. S. R. also contributed considerably to the increased world output. Canada, Trinidad, Argentina, Hungary, and Egypt produced more oil in 1941 than in 1940. However, these increases in crude-petroleum production were in part offset by declines in the petroleum output of European and Asiatic countries, as well as in Mexico, Ecuador, and Peru.

The Western Hemisphere supplied 78 percent of the world output in 1940 and 79 percent in 1941. Production of crude in Venezuela, third in rank in the world, revived in 1941 from the decline of the preceding year and surpassed all previous records. The 23-percent increase from 1940 to 1941 was due primarily to greater output in the Maracaibo fields of Tia Juana, Lagunillas, Cabimas, El Cubo, and La Concepcion and secondarily to increases in Cumarebo, and in the Eastern fields of Oficina, Jusepin, San Joaquin, El Roble, and Santa Ana. Production at Mene Grande revived, whereas Quiriquire, Temblador, Bachaquero, and Pedernales showed declines. A promising new field, Santa Barbara, in northern Monagas, was brought in near the end of 1941.

Increased output in the Comodoro Rivadavia field, the major producer, and especially in Mendoza raised the petroleum production of

[2] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Argentina from 1940 to 1941, in spite of a decline in the Plaza Huincul field. The Government enterprise (Y. P. F.) increased its yield 12 percent and supplied 64 percent of the national production, but both the absolute output and the proportional share of the private companies declined.

In Colombia, both the De Mares and the Barco concessions showed smaller yield in 1941 than in 1940. In Peru, a sharp decrease in the Lobitos field offset an increase in the La Brea and Parinas fields and

Crude petroleum produced in principal countries of the world, 1937–41, in thousands of barrels

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940 [1]	1941 [1]
North America:					
Canada	2,944	6,966	7,838	8,591	10,125
Mexico	46,907	38,506	42,898	44,036	43,837
Trinidad	15,503	17,737	19,270	20,219	21,211
United States	1,279,160	1,214,355	1,264,962	1,353,214	1,404,182
Other North America	33	78	112	142	150
Total North America	1,344,547	1,277,642	1,335,080	1,426,202	1,479,505
South America:					
Argentina	16,355	17,076	18,613	20,609	21,763
Bolivia	122	226	215	288	230
Colombia	20,599	21,582	23,857	25,593	24,553
Ecuador	2,161	2,246	2,313	2,349	1,557
Peru	17,457	15,839	13,508	12,126	11,922
Venezuela	186,230	188,174	206,470	185,570	223,784
Total South America	242,924	245,143	264,976	246,535	283,809
Europe:					
Albania	619	752	934	1,497	1,381
Czechoslovakia	123	130	120	119	109
France	502	513	500	496	479
Germany	3,176	3,861	4,487	4,544	4,438
Austria	221	383	693	719	692
Hungary	16	288	1,103	1,755	2,474
Italy	110	101	91	57	46
Poland	3,716	3,763	3,898	3,891	3,319
Rumania	52,452	48,487	45,483	42,182	38,147
U. S. S. R. [2]	193,241	204,956	216,866	218,600	238,150
Other Europe	4	9	10	10	10
Total Europe [2]	254,180	263,243	274,185	273,870	289,245
Asia:					
Bahrein Island	7,762	8,298	7,589	7,074	6,794
Burma	7,848	7,538	7,873	7,731	7,762
India, British	2,162	2,488	2,327	2,250	2,270
Iran (Persia)	77,804	78,372	78,151	66,900	64,000
Iraq	31,836	32,643	30,791	24,225	12,650
Japan (including Taiwan)	2,488	2,511	2,654	2,639	2,659
Netherlands Indies	56,724	57,318	62,087	62,011	53,704
Sakhalin	3,656	[3] 3,821	[3] 4,000	[3] 4,000	[3] 4,000
Sarawak and Brunei	6,009	6,913	7,097	7,047	6,864
Saudi Arabia	65	495	3,934	5,365	5,871
Total Asia [4]	196,354	200,397	206,503	189,242	166,574
Africa:					
Egypt	1,196	1,581	4,666	6,053	7,659
Other Africa	22	27	27	27	27
Total Africa	1,218	1,608	4,693	6,080	7,686
Australia and New Zealand	4	4	3	3	3
Undistributed	4	4	4	14	14
Grand total	2,039,231	1,988,041	2,085,444	2,141,946	2,226,836

[1] Approximate production. Data derived in part from World Petroleum, vol. 12, No. 2, February 1941, pp. 20–21, and vol. 13, No. 3, March 1942, p. 88.
[2] Includes U. S. S. R. fields in Asia, other than Sakhalin.
[3] Approximate production.
[4] Exclusive of U. S. S. R. fields in Asia, other than Sakhalin, which are included with U. S. S. R. in Europe.

lowered the national output of petroleum. Ecuadorian production of crude petroleum also declined from 1940 to 1941.

In Mexico, although output of petroleum increased in the Naranjos and Isthmus fields, a decline in Poza Rica, the major producer, and in the Panuco field reduced the national output.

In Canada, the increased output of the limestone oil wells of Turner Valley, Alberta, raised the petroleum production of the Dominion.

In Europe, excluding U. S. S. R., Hungary was the only country that increased its petroleum production. Production in Rumania, the major producer of central and western Europe, was 10 percent less in 1941 than in 1940, if unofficial figures are reliable.

In Asia difficulties of transport arising from the war reduced petroleum production. The output in Iraq in 1941 was little more than half of the 1940 figure. Iran and the Netherlands East Indies curtailed their petroleum production in 1941. Production in Burma and British India remained virtually stationary. In contrast, Saudi Arabia showed a small increase.

In Egypt the prolific Ras Gharib field increased the national production of petroleum.

FOREIGN TRADE [3]

Imports.—Imports of mineral oils, crude and refined, into continental United States increased 7,360,000 barrels in the first 9 months of 1941 over the corresponding months of 1940. During the same period the domestic demand for all oils rose 116,459,000 barrels, whereas exports declined 27,198,000 barrels, giving an increase of 89,261,000 barrels in total demand from January–September 1940 to January–September 1941. As the production of crude petroleum, natural gasoline, and benzol was only 11,421,000 barrels higher in the first three quarters of 1941 than in the corresponding quarters of 1940, altogether 18,431,000 barrels were withdrawn from storage between January and September 1941 compared with additions of 52,049,000 barrels added to stocks during the first 9 months of 1940. Imports of mineral oils, crude and refined, constituted 5.9 percent of the total new supply in continental United States during the first 9 months of 1941 compared with 5.3 percent during the corresponding months of 1940.

The chief increases in imports of mineral oils into continental United States from January–September 1940 to January–September 1941 were in crude petroleum, residual fuel oil, and distillate fuel oil. These increases were offset to a considerable extent by a sharp drop in imports of unfinished oils for further processing.

Exports.—Continental United States continued to be a net exporter of mineral oils, but the excess of exports over imports in the first 9 months of 1940 was reduced from 42,764,000 barrels to 8,206,000 barrels in the corresponding months of 1941. The excess of exports over imports in the first 9 months of 1941 was in refined oils. Actually continental United States imported 10,715,000 barrels more crude petroleum than it exported during the first 9 months of 1941 compared with net exports of 10,194,000 barrels in the first three quarters of 1940. Owing to the war situation and the difficulty of shipping oils to Europe, net exports of gasoline, distillate fuel oil, lubricating oils,

[3] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

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Mineral oils, crude and refined, imported into continental United States, January–September 1940–41 [1]

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total Jan.–Sept.
1940										
Crude petroleum	1,950	2,343	2,895	3,169	4,097	3,688	3,981	4,223	3,912	30,258
Refined products:										
Gasoline, finished	18	3	, 24	-----	16	3	5	2	8	79
Kerosine	-----	-----	-----	-----	-----	-----	68	-----	67	135
Distillate fuel oil	-----	542	358	326	201	159	215	301	262	2,364
Residual fuel oil	1,882	3,044	4,128	1,930	1,327	2,139	1,397	2,384	1,709	19,940
Paraffin wax	24	14	19	45	31	8	19	57	26	243
Asphalt	25	10	5	2	1	2	102	173	55	375
Unfinished oils, other	813	671	564	734	761	687	775	689	583	6,277
	4,712	6,627	7,993	6,206	6,434	6,686	6,562	7,829	6,622	59,671
1941										
Crude petroleum	2,793	3,371	3,821	3,831	3,866	4,332	5,331	4,327	4,662	36,334
Refined products:										
Gasoline, finished	-----	-----	1	-----	-----	-----	-----	363	232	596
Kerosine	-----	-----	43	-----	-----	-----	-----	-----	15	58
Distillate fuel oil	421	483	277	195	300	211	562	463	795	3,707
Residual fuel oil	2,211	2,616	4,210	2,406	2,143	2,083	1,085	2,611	4,217	23,582
Lubricating oil	-----	1	-----	-----	-----	-----	-----	-----	-----	1
Paraffin wax	1	7	-----	7	-----	-----	-----	3	5	23
Asphalt	2	54	70	22	13	42	102	80	57	442
Unfinished oils, other	275	226	376	258	355	384	184	107	123	2,288
	5,703	6,758	8,798	6,719	6,677	7,052	7,264	7,954	10,106	67,031

[1] Imports of crude as reported to Bureau of Mines; imports of refined products compiled from data of Department of Commerce; figures may differ slightly from those used throughout other sections of this report.

and kerosine were less in the first 9 months of 1941 than in the corresponding months of 1940. Residual fuel oil constituted an exception to the refined oils, which are normally exported in greater quantities than they are imported. Net imports of residual fuel oil increased from 7,476,000 barrels in the first 9 months of 1940 to 12,786,000 barrels in the corresponding months of 1941.

In absolute amounts, exports and Territorial shipments of mineral oils, both crude and refined, were smaller from January to September 1941 than from January to September 1940. The sharpest decrease both absolutely and proportionally was in outward shipments of crude petroleum. Of the refined oils, the greatest decreases were in exports and shipments of motor fuel, of distillate fuel oil, of lubricating oils, and of residual fuel oil.

Mineral oils, crude and refined, shipped from continental United States and including shipments to noncontiguous Territories, January–September 1940–41, by classes and months [1]

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total Jan.–Sept.
1940										
Crude petroleum	4,202	3,327	4,046	4,262	4,886	5,692	5,607	4,170	4,260	40,452
Refined products:										
Motor fuel:[2]										
Aviation[3]	155	125	249	302	415	646	210	569	301	2,972
Other	2,119	1,778	2,016	1,773	1,577	1,935	1,476	1,518	1,606	15,798
Total motor fuel	2,274	1,903	2,265	2,075	1,992	2,581	1,686	2,087	1,907	18,770
Kerosine	391	298	485	399	386	332	227	230	178	2,926
Distillate fuel oil	1,549	1,234	2,318	1,966	2,130	2,129	1,837	1,469	947	15,579
Residual fuel oil	1,139	769	932	1,532	1,379	1,959	1,387	1,815	1,552	12,464
Lubricating oil	1,068	1,089	1,193	1,161	1,173	1,075	741	727	393	8,620
Paraffin wax	76	101	91	68	80	47	32	32	41	568
Coke	83	27	69	137	115	154	100	181	135	1,001
Asphalt	106	133	104	162	169	194	137	176	93	1,274
Miscellaneous oils	40	211	126	85	117	45	72	43	42	781
Total refined	6,726	5,765	7,583	7,585	7,541	8,516	6,219	6,760	5,288	61,983
Total crude and refined	10,928	9,092	11,629	11,847	12,427	14,208	11,826	10,930	9,548	102,435
1941										
Crude petroleum	1,687	1,342	1,988	2,503	4,339	3,934	3,651	3,275	2,900	25,619
Refined products:										
Motor fuel:[2]										
Aviation[3]	440	355	497	63	373	386	153	777	483	3,527
Other	1,605	898	1,241	1,465	1,215	876	1,263	1,923	1,992	12,478
Total motor fuel	2,045	1,253	1,738	1,528	1,588	1,262	1,416	2,700	2,475	16,005
Kerosine	92	82	165	180	171	112	110	400	314	1,626
Distillate fuel oil	1,595	791	1,028	876	1,156	1,380	1,164	2,300	1,110	11,400
Residual fuel oil	1,002	975	1,170	1,378	981	1,267	954	1,600	1,469	10,796
Lubricating oil	534	744	703	775	1,118	831	735	900	580	6,920
Paraffin wax	47	36	49	42	52	56	60	60	72	474
Coke	57	75	52	85	178	157	113	146	63	926
Asphalt	120	74	105	128	142	103	103	128	126	1,029
Miscellaneous oils	39	45	53	68	52	48	48	50	39	442
Total refined	5,531	4,075	5,063	5,060	5,438	5,216	4,703	8,284	6,248	49,618
Total crude and refined	7,218	5,417	7,051	7,563	9,777	9,150	8,354	11,559	9,148	75,237

[1] Compiled from the records of the Department of Commerce; figures may differ slightly from those used throughout other sections of this report.

[2] Includes benzol, natural gasoline, and (since June 1, 1940) antiknock compounds.

[3] Includes antiknock compounds beginning with June 1940. Data for January to May 1940, inclusive, may be found in motor-fuel section.

INTERCOASTAL SHIPMENTS [4]

Receipts of mineral oils, crude and refined, on the East coast from Gulf coast ports were slightly larger in 1941 than in 1940. Crude petroleum was the largest single item in these shipments and constituted 34 percent of the total shipments in 1941. However, shipments of crude petroleum from Gulf coast to East coast ports were 9.1 percent smaller in 1941 than in 1940. Increased shipments of refined oils, however, more than offset the decrease in shipments of crude petroleum from 1940 to 1941. The principal gain was in shipments of gasoline, which were 9.6 percent larger in 1941 than in 1940; however, less kerosine and less distillate fuel oil were shipped from Gulf coast to Atlantic coast ports in 1941 than in 1940.

[4] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Mineral oils, crude and refined, shipped from Gulf coast to East coast ports of the United States, 1940–41, by classes [1]

[Thousands of barrels]

Class	1941						
	Jan.	Feb.	Mar.	Apr.	May	June	July
Crude petroleum	12,887	11,591	12,608	14,198	13,447	12,318	13,009
Gasoline	10,035	8,568	10,021	11,637	13,877	12,921	11,948
Kerosine	3,481	2,450	2,097	2,075	1,310	1,200	1,657
Distillate fuel oil	5,752	4,687	3,159	3,114	2,774	2,689	2,876
Residual fuel oil	7,403	6,969	6,411	6,613	5,453	6,536	6,004
Lubricating oil	545	383	545	770	889	854	849
Miscellaneous oils	31	4	39	96	92	152	72
	40,134	34,652	34,880	38,503	37,842	36,670	36,415

Class	1941						1940 (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Crude petroleum	12,866	10,704	10,985	11,191	11,484	147,288	162,063
Gasoline	11,803	9,773	10,672	10,020	9,259	130,534	119,142
Kerosine	1,724	2,417	2,254	2,401	2,234	25,300	27,262
Distillate fuel oil	3,397	3,634	3,211	2,943	4,384	42,620	44,429
Residual fuel oil	5,871	5,185	6,318	7,010	6,150	75,923	67,346
Lubricating oil	973	590	589	700	461	8,148	7,463
Miscellaneous oils	141	63	75	79	112	956	616
	36,775	32,366	34,104	34,344	34,084	430,769	428,321

[1] Petroleum Conservation Division, U. S. Department of the Interior.

NATURAL GAS [1]

By F. S. Lott and G. R. Hopkins [2]

SUMMARY OUTLINE

SUMMARY

The watchword of the natural-gas industry during 1941 was war service, as problems generated by the greatest industrial effort in history dominated policy and managerial activities in all parts of the country. These problems were mainly of four broad types: (1) Gas supply for expanding markets, particularly in the Appalachian region; (2) transportation facilities to bring gas to consuming centers whose requirements were growing rapidly; (3) availability of materials and equipment essential to effective functioning of gas utilities; and (4) measures to protect installations from possible damage by sabotage or enemy attack. As months passed, the solution of these problems became more urgent until hostilities opened on December 7, 1941. From that date it was fully realized that natural gas, wherever available, must aid war production without hindrance, despite increasing difficulties.

Marketed production of natural gas, in reaching a new high of 2,770 billion cubic feet in 1941, exceeded the record of 1940 by 4 percent (see fig. 1). The gain in demand was mostly from industrial consumers, as warm weather restricted domestic gas use to about the level of 1940. The sharpest gains were made in use by miscellaneous industrials (18 percent) and portland-cement plants (29 percent), which felt the full impetus of war demands.

The average value of natural gas at the producing wells is estimated to have reversed in 1941 the persistent decline of many years, and to have increased to 4.7 cents per thousand cubic feet from 4.5 cents in 1940. The chief causes were firming tendencies in the field price of gas in important southwestern fields and marked expansion of Appalachian gas production.

The average value at points of consumption increased to about 22.0 cents per thousand cubic feet in 1941 from 21.7 cents in 1940. A rise in the average industrial value to about 10.3 cents from 9.5 in 1940 is

[1] Data for 1941 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by H. Backus, Petroleum Economics Division, Bureau of Mines.

thought to have more than balanced the effects of declines in domestic and commercial values. The total sales value of natural gas to ultimate consumers was about $608,000,000 in 1941—5 percent more than in 1940 and the highest on record.

No imports of natural gas from Canada or Mexico were reported during 1941. Exports to Mexico increased 30 percent over 1940 to about 7,100 million cubic feet, highest since 1936. The small volume of natural gas piped to Canada in the form of mixed gas was about 121 million cubic feet in 1941, up from 90 million in 1940.

Salient statistics of natural gas in the United States, 1937–41

	1937	1938	1939	1940	1941 [1]
Marketed production:					
California .... millions of cubic feet..	329,769	315,168	348,361	351,950	370,000
Louisiana .... do....	315,301	283,899	294,370	343,191	410,000
Oklahoma .... do....	296,260	263,164	250,875	257,626	248,000
Texas .... do....	854,561	882,473	979,427	1,063,538	1,060,000
West Virginia .... do....	149,084	134,342	159,226	188,751	210,000
Other States .... do....	462,645	416,516	444,497	455,166	472,000
Total production .... do....	2,407,620	2,295,562	2,476,756	2,660,222	2,770,000
Exports—					
To Canada .... do....	78	94	76	90	121
To Mexico .... do....	4,790	1,743	3,046	5,473	7,100
Imports from Canada .... do....	289	372	131	....	....
Consumption.					
Domestic .... do....	371,844	367,772	391,153	443,646	447,000
Commercial .... do....	117,390	114,296	118,334	134,644	143,000
Industrial					
Field .... do....	651,320	659,203	680,884	711,861	640,000
Carbon-black plants .... do....	341,085	324,950	347,270	368,802	365,377
Petroleum refineries .... do....	113,005	109,741	97,685	128,007	150,000
Electric public-utility power plants [2] millions of cubic feet..	170,567	169,988	191,131	183,156	203,323
Portland-cement plants [3] .... do....	40,450	37,336	40,233	41,949	54,208
Other industrial .... do....	597,380	510,811	607,075	642,594	759,871
Total consumption .... do....	2,403,041	2,294,097	2,473,765	2,654,659	2,762,779
Domestic .... percent of total..	15	16	16	17	16
Commercial .... do....	5	5	5	5	5
Industrial .... do....	80	79	79	78	79
Number of consumers:					
Domestic .... thousands..	8,348	8,570	8,888	9,245	(4)
Commercial .... do....	680	695	715	741	(4)
Industrial [5] .... do....	39	39	40	41	(4)
Number of producing gas wells	55,050	53,770	53,530	53,880	(4)
Value (at wells) of gas produced					
Total .... thousands of dollars..	123,457	113,571	120,243	120,493	130,190
Average per M cubic feet .... cents..	5.1	4.9	4.9	4.5	4.7
Value (at points of consumption) of gas consumed.					
Domestic .... thousands of dollars..	273,577	273,070	287,600	315,515	316,476
Commercial .... do....	57,161	56,247	58,494	64,399	67,782
Industrial .... do....	196,791	171,233	187,627	197,090	223,796
Total value .... do....	527,529	500,550	533,721	577,004	608,054
Average per M cubic feet:					
Domestic .... cents..	73.6	74.2	73.5	71.1	70.8
Commercial .... do....	48.7	49.2	49.4	47.8	47.4
Industrial .... do....	10.3	9.4	9.6	9.5	10.3
Domestic and commercial .... do....	67.6	68.3	67.9	65.7	65.1
Domestic, commercial, and industrial cents..	22.0	21.8	21.6	21.7	22.0
Treated for natural gasoline:					
Quantity .... millions of cubic feet..	2,108,800	2,035,562	2,150,000	2,471,400	2,900,000
Percent of total consumption	88	89	87	93	[6] 105

[1] Subject to revision.
[2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook.
[4] Figures not yet available.
[5] Exclusive of oil- and gas-field operators.
[6] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is not marketed.

The number of consumers of natural gas increased 4 percent over 1939 to a total of 10,027,000 in 1940. More meters were reported in each of the 34 States in which natural gas is sold and in the District of Columbia. By the end of 1941 the number of meters served with natural gas had risen to at least 10,400,000.

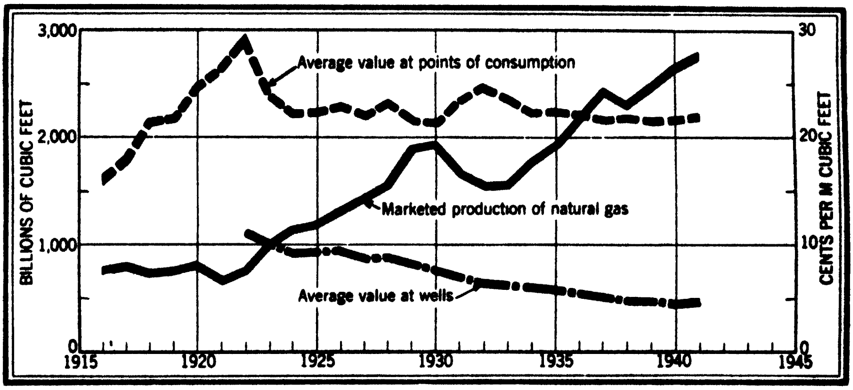

FIGURE 1.—Production and value of natural gas in the United States, 1916–41.

LEGISLATIVE AND LEGAL REVIEW

A natural-gas and natural-gasoline section was set up in the Office of the Petroleum Coordinator for National Defense on October 23, 1941. Its purposes are to integrate the activities of the gas industry in production, transportation, and distribution so as to serve the needs of a dynamic war economy effectively and to eliminate wasteful or nonessential use by the industry of critical materials, particularly steel.

Five district offices were opened, corresponding to those previously established for the petroleum industry, and surveys were begun in each district to determine the supply-and-demand situation and the problems to be anticipated. On December 23, 1941, General Preference Order M–68 was issued providing for acquisition of materials and supplies by oil and gas operators who comply with operating restrictions set up by the Petroleum Coordinator. The spacing pattern prescribed for gas wells was one well to each 640 surface acres of land. The immediate effect of this order was to curtail development work sharply in some currently active fields, but wildcatting did not seem to have been affected. The 640-acre-per-well rule was relaxed later in certain shallow producing areas where closer spacing had been common practice.

An amendment to the Natural Gas Act was signed by the President on February 7, 1942, broadening the jurisdiction of the Federal Power Commission over construction of natural-gas lines. Henceforth the approval of the Commission must be obtained before new gas-transmission lines are laid, whether or not the territory to be entered is already served by a natural-gas company.

The Commission was also given great power over gas rates by an important decision of the United States Supreme Court rendered March 16, 1942. It provides that property valuation, a focus of contention for many years, is no longer required as a basis for making

natural-gas rates. The "prudent investment theory" or others may now be used, and courts are directed in future not to set aside rates that are reasonable and on which fair hearings have been held by regulatory bodies.

GROSS PRODUCTION

In 1940 the estimated gross production of natural gas (3,694,100 million cubic feet) was 11 percent above 1939. Continued sharp gains in Texas and Illinois supplied most of the increased volume, with West Virginia, Louisiana, and Arkansas contributing materially. Notable declines occurred in New Mexico, New York, and Mississippi, the last two being caused by shortages of supply.

Reported gas production from gas wells increased 40 percent from 1935 to 1940; the trend was dominated by marked expansion in Texas and lesser growth in West Virginia, Louisiana, Kansas, and California. The recorded gas output of oil wells increased more rapidly in this interval, gaining 59 percent. The exploitation of large fields with high gas : oil ratios in Illinois, Louisiana, New Mexico, and Texas was the chief stimulus to this type of gas production.

The principal change in repressuring and pressure-maintenance operations in recent years is ascribed to the spectacular advance of the cycling process in Texas condensate fields, as indicated by volume data on Texas gas used for repressuring. It was as follows in cubic feet: 1938, 20 billion; 1939, 105 billion; and 1940, 294 billion. Similar activities in Louisiana are beginning to produce a pronounced upward trend there also. In California and Oklahoma the largest gas-repressuring volume was reported in 1935, but declining trends have persisted in both States since that year.

The volume of gas reported annually as stored in depleted natural reservoirs for future use has been relatively constant since 1935, averaging about 12 billion cubic feet a year. However, storage in 1940 was almost double the low volume of 1939 as the Appalachian States made sharp increases. Availability of numerous suitable fields in this region is a great aid to gas companies in meeting the winter peaks in demand and permitting longer-term storage.

The apparent loss and waste of gas decreased slightly in 1940, dropping to 655,967 million cubic feet, or 18 percent of the estimated gross production. Large reductions were shown in Louisiana, New Mexico, and Texas. Waste of gas in Illinois became important in 1938, with the new flush oil development, and increased rapidly throughout 1940 in the absence of State regulation.

Gross production and disposition of natural gas in the United States, 1939–40, by States, in millions of cubic feet

State	Estimated production [1]			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Repressuring	Stored in ground	Losses and waste [2]
1939							
Arkansas	6,200	17,800	24,000	10,107	952		12,941
California	27,000	403,000	430,000	348,361	22,487	5,918	53,234
Colorado	1,850	450	2,300	2,015			285
Illinois	1,200	61,800	63,000	2,746	397		59,857
Indiana	950	450	1,400	791			609
Kansas	66,000	44,000	110,000	80,556	1,436	[3] 425	27,925
Kentucky	48,500	4,500	53,000	47,771	208		4,845
Louisiana	288,000	125,000	413,000	294,370	9,340		109,290
Michigan	9,150	2,250	11,400	10,726			674
Mississippi	15,290	10	15,300	14,527			773
Missouri	640	10	650	538			112
Montana	22,800	1,200	24,000	23,178	23		799
New Mexico	35,000	110,000	145,000	60,284	31		84,685
New York	30,900	100	31,000	29,222	85		1,466
Ohio	40,600	3,400	44,000	36,469	3,995	[4] 687	3,345
Oklahoma	76,000	234,000	310,000	250,875	13,896	65	45,042
Pennsylvania	97,000	6,500	103,500	93,882	733	[5] 831	8,437
Texas	880,000	450,000	1,330,000	979,427	105,000		245,353
West Virginia	158,000	14,000	172,000	159,226	2,946	[6] 106	9,446
Wyoming	22,500	22,200	44,700	26,614	9,872		8,014
Other States [7]	5,240	10	5,250	5,071			179
	1,832,820	1,500,680	3,333,500	2,476,756	171,401	8,032	677,311
1940 [8]							
Arkansas	8,500	32,500	41,000	14,379	860		25,761
California	25,200	404,800	430,000	351,950	12,145	6,287	59,618
Colorado	2,500	400	2,900	2,533			367
Illinois	1,100	129,900	131,000	8,359	749		121,892
Indiana	1,200	2,000	3,200	1,137			2,063
Kansas	75,000	40,000	115,000	90,003	2,817	[9] 1,162	21,916
Kentucky	54,000	5,000	59,000	53,056	210	[10] 483	4,711
Louisiana	285,000	150,000	435,000	343,191	21,000		70,809
Michigan	10,000	4,000	14,000	12,648			1,352
Mississippi	6,500	300	6,800	6,365			435
Missouri	390	10	400	310			90
Montana	25,900	1,300	27,200	26,231			969
New Mexico	32,000	94,000	126,000	63,990	31		61,979
New York	15,100	100	15,200	12,187	12	[11] 414	2,696
Ohio	46,400	3,600	50,000	40,639	3,050	[12] 3,706	5,218
Oklahoma	90,000	220,000	310,000	257,626	14,463	794	36,744
Pennsylvania	96,000	6,000	102,000	90,725	826	[13] 1,723	9,212
Texas	1,100,000	475,000	1,575,000	1,063,538	294,000		216,937
West Virginia	193,000	12,000	205,000	188,751	3,583	[14] 426	9,572
Wyoming	22,000	18,000	40,000	27,346	9,170		3,484
Other States [7]	5,390	10	5,400	5,258			142
	2,095,180	1,598,920	3,694,100	2,660,222	362,916	14,995	655,967

[1] Marketed production plus quantities used in repressuring, stored in ground, lost and wasted (see footnote 2).
[2] Includes gas (mostly residue gas) blown to the air, shrinkage at natural-gasoline plants, and transportation losses but does not include direct waste on producing properties, except where data are available.
[3] Produced approximately as follows: 220 million cubic feet in Texas, 122 million in Oklahoma, and 83 million in Kansas.
[4] Produced approximately as follows: 86 million cubic feet in Kentucky, 4 million in Pennsylvania, 406 million in West Virginia, and 191 million in Ohio.
[5] Produced approximately as follows: 227 million cubic feet in New York, 444 million in Pennsylvania, 128 million in West Virginia, and 32 million in Kentucky.
[6] Produced approximately as follows: 58 million cubic feet in Kentucky and 48 million in West Virginia.
[7] North Dakota, South Dakota, Tennessee, Utah, Virginia, and Washington.
[8] Subject to revision.
[9] Produced approximately as follows: 373 million cubic feet in Oklahoma, 525 million in Texas, and 264 million in Kansas.
[10] Produced approximately as follows: 183 million cubic feet in West Virginia and 300 million in Kentucky.
[11] Produced approximately as follows: 109 million cubic feet in Pennsylvania and 305 million in New York.
[12] Produced approximately as follows: 397 million cubic feet in Kentucky, 2,216 million in West Virginia, and 1,093 million in Ohio.
[13] Produced approximately as follows: 178 million cubic feet in Kentucky, 424 million in West Virginia, and 1,121 million in Pennsylvania.
[14] Produced approximately as follows: 148 million cubic feet in Kentucky, 7 million in Pennsylvania, and 271 million in West Virginia.

MARKETED PRODUCTION

A new peak in marketed production of natural gas was attained in 1941—an estimated total of 2,770 billion cubic feet, 4 percent above 1940. Larger output from producing States was general, but Louisiana apparently made the greatest gain. Production in Oklahoma declined slightly, and that of Mississippi and of New York fell sharply as available gas reserves continued to shrink, lacking the stimulus of substantial new discoveries.

Final 1940 data show expansion of output in all producing States except Mississippi, New York, Pennsylvania, and the "Other" group of small producers. New York reached a sharp peak in gas production in 1938 and Mississippi in 1939, followed by unusually abrupt declines.

Natural gas produced in the United States and delivered to consumers, 1936–40, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
1936	8, 500	320, 406	3, 687	865	2, 241	69, 178	43, 903	290, 151	7, 167	11, 821	23, 003	33, 928
1937	9, 690	329, 769	3, 186	1, 040	1, 551	83, 890	55, 719	315, 301	9, 080	13, 348	24, 765	46, 337
1938	11, 301	315, 168	1, 904	1, 169	1, 299	75, 203	46, 163	283, 899	10, 165	13, 656	21, 216	50, 706
1939	10, 107	348, 361	2, 015	2, 746	791	80, 556	47, 771	294, 370	10, 726	14, 527	23, 178	60, 284
1940	14, 379	351, 950	2, 533	8, 359	1, 137	90, 003	53, 056	343, 191	12, 648	6, 365	26, 231	63, 990

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Other States	Total	Value at points of consumption	
										Total (thousands of dollars)	Average per M cubic feet (cents)
1936	12, 431	46, 994	280, 481	110, 362	734, 561	138, 076	29, 322	725	2, 167, 802	476, 813	22. 0
1937	21, 325	42, 783	296, 260	115, 928	854, 561	149, 084	31, 023	2, 980	2, 407, 620	528, 354	21. 9
1938	39, 402	35, 257	263, 164	76, 547	882, 473	134, 342	26, 678	5, 850	2, 295, 562	500, 698	21. 8
1939	29, 222	36, 469	250, 875	93, 882	979, 427	159, 226	26, 614	5, 609	2, 476, 756	534, 240	21. 6
1940	12, 187	40, 639	257, 626	90, 725	1,063,538	188, 751	27, 346	5, 568	2, 660, 222	577, 939	21. 7

The average value of natural gas at the wells, which has been falling steadily for many years, reached a new low in 1940 at 4.5 cents per thousand cubic feet. Contributing to this decline have been reductions in average sales prices for gas in the field in nearly all producing districts and—of perhaps greater influence—the shift in location of the chief sources of gas supply from the old eastern fields to the Southwest, where unit costs of producing gas are much lower. Suggestive of these two processes are the following data: In 1928 the Appalachian States as a group sold 22 percent of the total marketed production of natural gas in the United States at an average wellhead value of 21.1 cents per thousand cubic feet. The principal southwestern gas-producing States marketed 57 percent of the total for the United States at a corresponding average of 4.7 cents per thousand cubic feet. In 1940 the same State groups marketed 15 and 68 percent, respectively, of the total at average values at the wells of 14.8 and 2.1 cents per thousand cubic feet.

Natural gas produced and consumed in the United States in 1940, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)
Ala	-----	-----	-----	-----	-----	-----	23, 461, 000	0. 9	$5, 794, 000	24. 7
Ariz	-----	-----	-----	-----	-----	-----	18, 002, 000	. 7	5, 253, 000	29. 2
Ark	14, 379, 000	0 5	$510, 000	3 5	$2, 622, 000	18. 2	39, 719, 000	1. 5	7, 244, 000	18. 2
Calif	351, 950, 000	13. 2	19, 604, 000	5. 6	90, 006, 000	25. 6	351, 950, 000	13. 3	90, 006, 000	25. 6
Colo	2, 533, 000	. 1	100, 000	3 9	573, 000	22 6	22, 111, 000	. 8	7, 995, 000	36. 2
D. C	-----	-----	-----	-----	-----	-----	4, 686, 000	. 2	3, 262, 000	69. 6
Fla	-----	-----	-----	-----	-----	-----	1, 481, 000	1	449, 000	30. 3
Ga	-----	-----	-----	-----	-----	-----	20, 551, 000	. 8	7, 867, 000	38. 3
Ill	8, 359, 000	. 3	228, 000	2. 7	1, 557, 000	18 6	88, 088, 000	3 3	40, 232, 000	45. 7
Ind	1, 137, 000	. 1	154, 000	13. 5	661, 000	58 1	29, 214, 000	1 1	10, 059, 000	34. 4
Iowa	-----	-----	-----	-----	-----	-----	23, 460, 000	. 9	8, 611, 000	36. 7
Kans	90, 003, 000	3. 4	3, 537, 000	3 9	31, 931, 000	35 5	96, 772, 000	3. 6	21, 057, 000	21. 8
Ky	53, 056, 000	2. 0	6, 903, 000	13 0	22, 936, 000	43. 2	18, 881, 000	. 7	8, 433, 000	44. 7
La	343, 191, 000	12. 9	10, 968, 000	3 2	63, 577, 000	18. 5	185, 089, 000	7. 0	22, 759, 000	12. 3
Md	-----	-----	-----	-----	-----	-----	5, 855, 000	. 2	2, 108, 000	36. 0
Mich	12, 648, 000	. 5	1, 561, 000	12 3	8, 339, 000	65 9	32, 790, 000	1. 2	28, 247, 000	86. 1
Minn	-----	-----	-----	-----	-----	-----	19, 904, 000	. 7	8, 276, 000	41. 6
Miss	6, 365, 000	. 2	294, 000	4. 6	1, 637, 000	25 7	17, 657, 000	. 7	5, 101, 000	28. 9
Mo	310, 000	(1)	41, 000	13 2	166, 000	53. 5	53, 141, 000	2 0	20, 197, 000	38. 0
Mont	26, 231, 000	1. 0	1, 178, 000	4 5	7, 132, 000	27 2	22, 328, 000	. 8	5, 572, 000	25. 0
Nebr	-----	-----	-----	-----	-----	-----	20, 087, 000	. 8	7, 330, 000	36. 5
N. Mex	[2] 63, 990, 000	2 4	985, 000	1. 5	10, 317, 000	16 1	40, 198, 000	1 5	4, 633, 000	11. 5
N. Y	[3] 12, 187, 000	. 5	2, 280, 000	18 7	8, 246, 000	67. 7	27, 250, 000	1. 0	18, 958, 000	69. 6
N. Dak	-----	-----	-----	-----	-----	-----	1, 725, 000	. 1	664, 000	38. 5
Ohio	40, 639, 000	1 5	6, 803, 000	16 7	20, 850, 000	51. 3	129, 856, 000	4. 9	66, 707, 500	51. 4
Okla	257, 626, 000	9. 7	3, 813, 000	1 5	31, 603, 000	12 3	230, 806, 000	8. 7	22, 295, 500	9. 7
Pa	[4] 90, 725, 000	3 4	18, 009, 000	19 9	41, 733, 000	46 0	121, 230, 000	4. 6	50, 456, 000	41. 6
S. Dak	9, 000	(1)	600	6. 7	3, 000	33 3	6, 454, 000	. 2	2, 210, 000	34. 2
Tenn	9, 000	(1)	1, 000	11 1	3, 000	33. 3	16, 819, 000	. 6	5, 425, 000	32. 3
Tex	[5] 1,063,538,000	40 0	19, 356, 000	1 8	151, 580, 000	14. 3	874, 294, 000	32. 9	63, 544, 000	7. 3
Utah	5, 124, 000	. 2	176, 400	3. 4	1, 063, 000	20 7	14, 802, 000	. 6	3, 079, 000	20. 8
Va	80, 000	(1)	8, 000	10 0	81, 000	101 3	963, 000	(1)	900, 000	93. 5
Wash	36, 000	(1)	3, 000	8 3	37, 000	102 8	36, 000	(1)	37, 000	102. 8
W. Va	188, 751, 000	7 1	23, 179, 000	12 3	76, 065, 000	40 3	77, 540, 000	2. 9	19, 388, 000	25. 0
Wyo	27, 346, 000	1 0	801, 000	2 9	5, 221, 000	19 1	17, 459, 000	. 7	2, 855, 000	16. 4
Total:										
1940	2, 660, 222, 000	100. 0	120, 493, 000	4 5	577, 939, 000	21. 7	2, 654, 659, 000	100. 0	577, 004, 000	21. 7
1939	2, 476, 756, 000	100. 0	120, 243, 000	4. 9	534, 240, 000	21 6	2, 473, 765, 000	100 0	533, 721, 000	21. 6

[1] Less than 0.05 percent.
[2] Includes 685,000 M cubic feet piped to Mexico.
[3] Includes 54,000 M cubic feet piped to Canada.
[4] Includes 36,000 M cubic feet piped to Canada.
[5] Includes 4,788,000 M cubic feet piped to Mexico.

WELLS

Reported completions (2,911) of gas wells in 1941 were 22 percent larger than the 1940 total and exceeded the number reported in the previous peak years of 1937 and 1929. Operators throughout the Appalachian region stepped up their drilling sharply as actual and prospective requirements threatened to tax all developed producing capacity. The increase in Appalachian completions approximated that of the entire country, as minor gains and losses in other districts about balanced each other.

The total number of producing gas wells on December 31, 1940, increased slightly over that on the corresponding date in 1939 to 53,880. Indicated abandonments of gas wells in 1940 were 2,032 a reduction

from 2,385 in 1939. Reports indicate that in recent years abandonments of old gas wells have exceeded total gas completions in the United States; thus, on December 31, 1930, 55,020 gas wells were reported, indicating that in the past decade 1,140 more gas wells have been abandoned than have been drilled.

Gas wells in the United States, 1939–41, by States

State	Producing Dec. 31, 1939	Drilled during 1940 [1]	Producing Dec. 31, 1940	Drilled during 1941 [1]
Arkansas	190	13	190	20
California	80	15	90	23
Colorado	20	1	20	4
Illinois	80	15	90	13
Indiana	960	77	970	56
Kansas	2,140	130	2,100	102
Kentucky	[2] 2,340	128	[2] 2,400	255
Louisiana	1,520	99	1,530	111
Michigan	310	59	350	97
Mississippi	30	1	30	4
Missouri	110	30	120	18
Montana	370	49	410	59
New Mexico	90	19	100	19
New York	2,040	20	2,030	18
Ohio	6,270	491	6,300	701
Oklahoma	2,420	176	2,430	159
Pennsylvania	18,100	273	18,130	386
Tennessee	([2])		([2])	
Texas	3,120	289	3,150	294
West Virginia	13,200	487	13,300	558
Wyoming	110	8	110	8
Other States [3]	30	2	30	6
	53,530	2,382	53,880	2,911

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] North Dakota, South Dakota, Utah, Virginia, and Washington.

TECHNOLOGIC DEVELOPMENTS

War needs have caused rapid developments in the use of natural gas and its liquefied gases as constituents in the production of an ever-growing list of essential chemicals. Many well-known substances that have long been made from other source materials—for example, ammonia, ammonium nitrate, acetylene, certain anesthetics, and alcohols—are now being, or soon will be, produced in quantity by processing the ligher hydrocarbons associated with petroleum. In addition, entirely new compounds frequently are developed and put to use. Valuable new explosives, for instance, have been produced by nitration of methane and synthesis of nitro-hydroxy compounds.

An interesting process for dehydrating alfalfa has been developed in Kansas. It is preferable to sun drying because it preserves the vitamin A content by preventing the destruction of carotin, a carbohydrate from which vitamin A is derived. The dehydration of vegetables by natural-gas heat is growing rapidly in California and promises to spread to other States. The shortage of transportation facilities, particularly shipping, resulting from the war is an active stimulant to use of foods that are dehydrated before shipment, reducing both the tonnage and bulk to be moved.

Few people apparently have realized until recently the extent to which the efficiency of gas pipe-lines has been reduced by corrosion and accumulation of dirt inside pipes. A few experimental runs were

made with scrapers adapted from types commonly used in cleaning the interior of oil and gasoline lines. A surprising quantity of debris and miscellaneous scrap metal was brought out; in consequence, the effective capacity of the pipe was increased materially. Systematic cleaning programs, as carried out by one large gas company in Texas during 1940 and 1941, have improved line efficiencies 15 to 25 percent. A much wider use of cleaning devices for the interior of gas lines is anticipated when the design of scrapers and the techniques of using them are improved further.

Two circumstances are thought to have fostered for some years comparative neglect of gas pipe-line interiors by tending to mask true performance characteristics. First, the old formula that has been used most widely in calculating pipe-line capacity is now recognized as inaccurate for high-pressure lines in that it indicates line capacity materially below actual for clean pipe. Second, few large gas lines operate at or near maximum capacity in actual practice, except for brief periods of peak gas demand. Therefore, opportunities to observe line performance under conditions of stress are neither frequent nor prolonged.

REVIEW OF FIELD DEVELOPMENTS BY STATES

Arkansas.—Records of the Arkansas Department of Revenue indicate that natural-gas production in Arkansas in 1941 was 24,617 million cubic feet, a 10-percent increase over 1940. Output of the dry-gas fields in the northwestern district increased 18 percent to 6,384 million cubic feet and that of the southern fields 7 percent to 18,233 million cubic feet.

Important new markets for Arkansas natural gas will be provided by industrial plants projected under the war-production program at Malvern, Benton, Little Rock, and Pine Bluff. The new gas load is expected to exceed 150 million cubic feet daily and will be obtained chiefly from the McKamie, Macedonia, and Dorcheat fields, whose combined gas reserves exceed 400 billion cubic feet.

Treating plants are under construction that will remove the sulfur and liquids from the gas efficiently before it enters transmission lines. About 200 tons a day of marketable sulfur will be recovered as a by-product, as well as 70,000 or more gallons a day of natural gasoline and liquefied petroleum gases.

Two discovery wells that produced gas and condensate were reported in 1941. In July the Macedonia field, Columbia County, was opened in sec. 16, T. 18 S., R. 21 W. by No. 1 Franks, which produced 330 barrels of condensate with gas from the Smackover limestone at 8,906 to 8,914 feet. The Patton field, Lafayette County, was discovered in November, when No. 1 Moore, in sec. 29, T. 17 S., R. 24 W., found 215 barrels a day of condensate with gas at 9,312 to 9,340 feet in the Smackover limestone.

Four condensate wells were completed in the Macedonia field in 1941, 11 at McKamie, and 2 at Dorcheat. One gas well was reported in sec. 3, T. 18 S., R. 13 W., Union County, which had a daily capacity of 20 million cubic feet from a depth of 3,569 feet. Only two gas completions were listed in the northwestern counties. One of these, in the Alma field, Crawford County, sec. 6, T. 9 N., R. 30 W., was drilled to 6,578 feet; the other, in sec. 31, T. 10 N., R. 26 W., Franklin

County, was completed for 12 million cubic feet a day from a total depth of 1,717 feet.

Repressuring with gas of the Jones oil sand in the Shuler field began in 1941 under a unit operating agreement fostered by the State regulatory authorities. By this means gas will be conserved, and recoverable oil reserves are expected to be increased materially.

California.—For the first half of 1941 marketed production of natural gas in California was 184,554 million cubic feet, a 7-percent increase over the comparable 1940 period. The source of information is a report from E. F. McNaughton, California Railroad Commission. The volume of gas reported blown to the air—17.1 billion cubic feet during the first half of 1940—was reduced to 7.3 billion for the similar period in 1941 after the peak of flush oil production at Montebello had passed.

Discoveries in 1941 included three oil fields with relatively high gas : oil ratios—Raisin City and Riverdale in Fresno County and Helms in Kings County. Large gas reserves were proved at Raisin City. A new dry-gas field of undetermined importance was discovered 12 miles southeast of the Tracy gas field, San Joaquin County, The gas comes from a thin sand at relatively shallow depth. Several new productive zones were discovered in fields throughout the State. The Paloma gas and "condensate" field was extended west and southeast. On March 24 all producing wells in this field except dry-gas wells were shut in to eliminate excessive waste of gas and pressure drop pending adoption of a unit plan of operation for gas injection and pressure maintenance. The wells were still shut in at the end of 1941.

In the Cole's Levee field important gas production was developed in 1941 about 3,000 feet above the oil-producing formation. Gas-utility pipe lines are conveniently near this field.

Completions in gas fields during 1941 numbered 18, of which 14 were at Rio Vista, 2 at Vernalis, 1 at McDonald Island, and 1 at Delano. In addition, 3 gas wells were reported at Cole's Levee, 1 at Union Avenue, 1 at Elwood, and 1 at Santa Fe Springs oil fields.

All rights to the La Goleta gas field were acquired in 1941 by a utility company. Large compressor units and other equipment were installed to prepare the field for use as a gas storage reservoir.

The increased demand for gas resulting from war activities has strained the capacity of some gas producing and transmission facilities. To guard against critical shortages of gas, the California Railroad Commission instituted a general investigation covering the State gas reserves, consumers' requirements and the ability to meet them, and the economic factors relating to industrial use of gas as opposed to oil or other fuels.

Colorado.—Natural-gas production continued to expand in 1941 to 2,713 million cubic feet—30 percent above the 1940 output. The data are taken from a report by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. Withdrawals from the Powder Wash field were begun in June 1941 after an outlet was provided by laying an 8-inch line connecting with the Salt Lake City transmission system in the Hiawatha field.

The Powder Wash production was 477.3 million cubic feet. Hiawatha and Thornburg production increased to 1,996.6 and 114.2 million cubic feet, respectively. The output of other fields declined and was as follows, in millions of cubic feet: Berthoud 50.4, Craig

4.2, and Garcia 70.2. Small amounts of gas were used in the field, and 110.3 million cubic feet were estimated to have been wasted in connection with the production of oil in the Wilson Creek field.

Four gas wells were completed in 1941, with a total daily initial capacity of 30.1 million cubic feet; two of these were at Powder Wash and two at Hiawatha.

Illinois.—Natural gas produced and marketed, exclusive of that used for field purposes, increased 46 percent to 1,699.4 million cubic feet in 1941, as reported by A. H. Bell and G. V. Cohee, Illinois Geological Survey, Urbana, Ill. The gas was produced in five fields, as follows: Russellville and Ayers gas fields, 863 and 13.4 million cubic feet, respectively; and Salem, Louden, and Albion oil fields, 165, 536, and 122 million cubic feet, respectively. The Salem and Louden gas is residue from gasoline plants.

Eight new gas wells were drilled in the Russellville gas field during 1941, and one was abandoned, leaving 48 active. The productive area of the Buchanan sand is about 1,600 acres and of the Bridgeport sand 260 acres. The initial daily production of the new wells averaged about 2 million cubic feet.

Estimated gas production of the Louden pool during 1941 was 13.7 billion cubic feet, and the daily average at the end of the year was about 36 million. Two gasoline plants process 15 million cubic feet daily, and 6 million cubic feet of residue gas are injected into the oil-producing sands. A line to St. Elmo and Brownstown takes about 1.4 million cubic feet of residue gas a day.

Salem-field gas production during 1941 is estimated to be 35.4 billion cubic feet, and production was about 82 million cubic feet daily at the end of the year. Three gasoline plants process 59 million cubic feet a day, of which 4 million cubic feet are returned to oil sands and 1 million used in Salem, Centralia, and Mount Vernon.

The Centralia field produced only 1.8 billion cubic feet of gas during 1941, the daily output having declined to about 4 million cubic feet in December; about 100,000 cubic feet a day were being returned to producing formations.

In the Storms field, the daily rate of gas production had declined 95 percent in 2 years to 5 million cubic feet at the end of 1941. Estimated 1941 output of gas was 2.2 billion cubic feet. Injection of 120,000 cubic feet a day was begun during 1941.

The New Harmony, Griffin (Indiana), and Keensburg oil fields produced an estimated 9 billion cubic feet of gas in 1941, the daily production being about 25 million cubic feet. A gasoline plant under construction is designed to take 20 million a day of this gas, and it is planned to return the residue gas to producing sands.

The Albion pool, Edwards County, now making about 1 million cubic feet of gas a day, produced about 445 million cubic feet in 1941, part of which was sold to a brick plant at Albion.

A group of fields of the Central Basin area in Jasper, Richland, Clay, Wayne, northern Hamilton, and northwestern White Counties increased their estimated gas output to 24.5 billion cubic feet during 1941. The new Johnsonville field, Wayne County, supplies more than one-third of this volume.

The fields on the south and southwest margin of the Illinois Basin in southern Illinois produced an estimated 14.5 billion cubic feet of gas. These include, among others, the more important producing

pools, such as Woodlawn, Jefferson County; Benton, Franklin County; and Rural Hill, Hoodville, and Dale, Hamilton County.

Indiana.—Production of natural gas increased 9 percent in 1941 to 1,355 million cubic feet, chiefly in consequence of new supplies from the North Glendale field discovered in 1941 in southern Daviess County and from old wells in the Unionville gas field, Monroe County, which had been shut in since discovery. Information is taken from a report by Robert G. Reno, State gas supervisor, Indianapolis.

The North Glendale field was discovered in sec. 16, T. 2 N., R. 6 W., in June 1941 by the McCracken No. 1, which produced one-half million cubic feet a day from the Cypress sand at 728 to 735 feet. Seven gas wells were completed by the end of 1941. An isolated gas well was completed in the old, abandoned, Francisville field in southern Pulaski County. It made one-half million cubic feet, with a rock pressure of 155 pounds. No other gas wells have been completed in the area.

Gas completions fell from 77 in 1940 to 56 in 1941 owing to the sharp decline in drilling in the Rockport field, which was largely drilled up in 1940. Development work in the Old Trenton area increased. Four additional Trenton wells were completed in the Unionport field, Randolph County—a 1940 discovery—and the field began producing about one-half million cubic feet of gas a day commercially in the latter part of 1941. Gas-well completions, by fields, included: Buffkin 1 (no market), Greensburg 12, North Glendale 7, Iva 2, Harrison County 6, Loogootee 1, Merom-Raley 3, Oatsville 1, Rockport 3, Unionville 1, Unionport 4, Veale 1, and Old Trenton (many counties) 13.

Gas production from most fields decreased moderately in 1941, although rather sharp declines were reported from the Harrison County and Troy-Tell City fields. The Rockport field, which now supplies about one-third of the Indiana gas production, increased its output 17 percent in 1941. Production in 1941, by fields, in millions of cubic feet was: Alford 60, Francisco 4.5, Greensburg 177.9, Harrison County 100, Hudsonville (including North Glendale) 31, Loogootee 5, Oaktown 96.6, Rockport 461, Shelburn-Grayville 33.9, Old Trenton (including Randolph County) 200, Troy-Tell City 1.5.

The Harmon gas field was abandoned in 1941 after 12 years of production. The Troy-Tell City field is almost depleted and probably will be abandoned in 1942.

Kansas.—Marketed production of natural gas in Kansas increased 10 percent in 1941 to about 99 billion cubic feet. Although small declines in output of most fields were the rule, a few large fields—notably Cunningham, Hugoton, and Thurber—had sharp increases, according to the Kansas Corporation Commission records. The McLouth field in Jefferson and Leavenworth Counties, which did not produce during 1940, had an output of 1,667 million cubic feet in 1941. The more important gas-producing fields were drawn upon for the following volumes during 1941, in billions of cubic feet: Hugoton 36.4, Cunningham 18.0, Otis 9.0, Medicine Lodge 7.1, Burrton 4.5, McPherson County 4.2, Thurber 3.4, and Lyons 2.4.

According to a report by R. P. Keroher, Kansas Geological Survey, 102 gas wells were reported in 1941—52 in eastern Kansas and 50 in the western part. Thirteen of the western wells and three of the eastern made oil with the gas.

Seven gas discoveries were reported, of which only one was in the eastern part of the State—the Robinson pool, Marion County, in sec. 15, T. 20 S., R. 5 E., where one well found gas in sand in the lower Cherokee formation. New gas wells were reported in certain eastern counties, including Cowley, Greenwood, Jefferson, Leavenworth, and Johnson. Development of the McLouth pool, a 1939 discovery, in Jefferson and Leavenworth Counties, was much the most important gas activity in eastern Kansas. A total daily potential of 260.6 million cubic feet was obtained from 39 wells.

Western Kansas discoveries were the Bergtal (sec. 22, T. 20 S., R. 15 W.) and Krukenberg (sec. 11, T. 19 S., R. 15 W.) pools in Barton County, the Zook (sec. 16, T. 23 S., R. 16 W.) pool in Pawnee County, the Preston (sec. 18, T. 26 S., R. 11 W.) and Ward (sec. 11, T. 26 S., R. 12 W.) pools in Pratt County, and the Hitz (sec. 4, T. 24 S., R. 12 W.) pool in Stafford County. The Bergtal and Zook pools produce from the Arbuckle limestone; the Krukenberg from the Lamotte sand; and the Preston, Ward, and Hitz pools from the Viola limestone.

New production was developed in old fields as follows: Otis pool had three wells with 24.6 million cubic feet of daily potential; Rick pool, one new well good for 1.8 million; Silica, two wells with 5.2 million; Kipp, two small wells; Zenith, three wells with 8.8 million; Medicine Lodge, one well with 22.8 million; Orth, one well with 38.4 million; and Thurber, three wells with 38.4 million. In the Cunningham-Cairo district of Kingman and Pratt Counties, 16 new wells were drilled, with a total daily capacity of 190.5 million cubic feet. Three of these were old wells that found deeper production. In the Hugoton field a daily potential of 184.1 million cubic feet was developed from 11 new wells.

According to available reports, which are not complete, the total daily potential of gas brought in during 1941 was 825.4 million cubic feet, of which 33 percent (276.7 million cubic feet) was in eastern Kansas. This represents a considerable decline in total new capacity from 1940, despite a sixfold increase in eastern counties owing to the exceptional McLouth-pool development.

Kentucky.—Drilling for gas in eastern Kentucky, particularly in the Big Sandy area, was about 100 percent more active in 1941 than in 1940 because of the growing need for gas in industrial districts to the north and east. A total of 233 gas wells was reported compared with 113 in 1940. The most active counties, with the number of gas-well completions, were: Floyd 65, Pike 72, Knott 45, Martin 32, and Johnson 14. In western Kentucky, 23 gas completions were reported in 1941 compared with 12 in 1940; 3 were in Ohio County, 2 in Muhlenberg, 2 in Daviess, 5 in Clay, 4 in Jackson, 4 in Knox, and 3 in Clinton.

Marketed production of Kentucky gas is estimated to have increased 12 percent in 1941 over 1940, owing chiefly to increased movement into West Virginia and Ohio.

A new gas field producing from the Big Six sand was opened in Johnson County 4 miles west of Paintsville. Extensions of gas-producing areas were made in Pike and Knott Counties.

In 1941 four deep tests to the Knox dolomite (Cambro-Ordovician) were completed in eastern Kentucky; all were failures. These wells were in Magoffin County on the Paint Creek uplift, in Elliott County on the Burke dome, in Laurel County on the Sinking Creek dome, and in Clark County in the Ruckerville fault area.

Louisiana.—In north Louisiana, gas-well completions in 1941 increased to 93, or 24 percent. Forty-eight of these were in the Monroe gas field, and the remainder were scattered. Reported gas completions in south Louisiana totaled 12 in 1940 and 18 in 1941. The producing formation at Monroe has been extensively treated with acid in recent years resulting in the satisfactory revival of many old wells of low current capacity.

Four gas discoveries were reported in northern Louisiana in 1941. Of possible wide significance was the finding of commercial quantities of oil or gas in the Smackover limestone for the first time in Louisiana. The discovery well was No. 1-A Meadows in the Lisbon field, Claiborne Parish, which was completed as a gas and condensate well from 10,148 to 10,398 feet. In sec. 36, T. 12 N., R. 3 E., Caldwell Parish, the No. 1 Lowe made 15 million cubic feet of gas from the Wilcox formation at 2,173 to 2,178 feet, after being plugged back from 4,009 feet. Three miles northwest of Lisbon, in sec. 11, T. 21 N., R. 4 W., the No. 1 Alford opened a new area when it produced 5 million cubic feet of gas and 80 barrels of condensate a day from the Pettit lime at 5,098 to 5,112 feet. A shallow discovery, in the Eocene at 1,462 to 1,465 feet, was made by No. 1 Hughes in sec. 22, T. 8 N., R. 1 E., La Salle Parish, good for 10 million cubic feet of gas after it had been plugged back from the Wilcox at 4,092 feet total depth.

In the Louisiana Gulf Coast section eight discoveries, all from the Miocene, were reported—one dry gas and seven condensate producers. The gas discovery, Bay Decherre in La Fourche Parish, was shallow (2,460 to 2,528 feet), but all the condensate wells were deep, producing at 6,750 to 10,883 feet. The latter were: Point Aufer and Lapeyrouse, Terrebonne Parish; Belle Isle, St. Mary's Parish; De Lacrois Island, Plaquemines Parish; Lakeside and Pecan Lake, Cameron Parish; and Lewisburg, Acadia Parish.

Records of the Louisiana Department of Minerals indicate that gross measured gas production in 1941 was 574.8 billion cubic feet—375.1 billion from gas wells and 199.7 billion from oil wells. North Louisiana produced 333.3 billion cubic feet from gas wells and 66.0 billion from oil wells. South Louisiana produced 41.8 billion from gas wells and 133.7 billion from oil wells. Gas processed for gasoline extraction rose from 145.2 billion cubic feet in 1940 to an estimated 250 billion in 1941. Several pipe-line construction projects increased the facilities for transporting Louisiana gas to important markets in other States during 1941.

About 55 billion cubic feet of gas were returned to producing formations in pressure-maintenance operations during 1941, or more than double the volume in any previous year. Three major projects were operating—at Tepetate, Ville Platte, and Cotton Valley—in addition to small ones. The cooperative installation at Cotton Valley is the largest in existence, having a rated daily capacity of 150 million cubic feet of gas. It started operating in July 1941. Liquid-product production is expected to exceed 10,500 barrels a day.

A fourth large pressure maintenance project, at South Jennings, Jefferson Davis Parish, began operating during the last week of 1941.

Michigan.—Reported natural-gas production reached a new high of 15,092 million cubic feet in 1941, or 6 percent more than in 1940, according to information from F. R. Frye, petroleum engineer, Michigan Department of Conservation.

In all, 97 gas wells were drilled, more than in any year since 1936. Activity was due chiefly to the development of fields discovered in 1940 and to the discovery and partial development of the Deerfield pool in western Isabella County—an extension of the old Broomfield pool. The discovery well—Winesburg No. 1, sec. 20, T. 14 N., R. 5 W.—was completed in March 1941 for 2.2 million cubic feet of ga. a day from the Michigan Stray sand at 1,292 feet. Twelve wells drilled in 1941 provided 2,000 acres for production. Further development is expected. Six wells were drilled in the Broomfield pool.

The Reed City gas field, Osceola County, discovered in November 1940, was expanded to cover 4,100 acres by drilling 24 gas wells. Production is from the Michigan Stray sand at 1,150 to 1,250 feet.

Sixteen gas wells were completed in the Marion gas field, Clare and Osceola Counties. Proved territory covers about 5,000 acres. Five wells were added to the Riverside pool, Missaukee County, increasing its probable productive area to 1,600 acres.

The Bateson No. 1 test in sec. 2, T. 14 N., R. 4 E., Bay County, which blew out in 1940 with a heavy flow of wet gas from 7,776 feet, was deepened to a record 10,445 feet. It penetrated the St. Peter sandstone but being dry in the deeper zones was plugged back to 7,800 feet and completed as a gas and "condensate" well.

In the Salem field, Allegan County, the Heasley No. 1 in sec. 21, T. 4 N., R. 13 W., was completed as a gas well in the Salina formation at 3,792 feet. Open-flow capacity was 304,000 cubic feet and closed pressure 1,150 pounds. The Evart gas pool was discovered in November 1941 by Wirth No. 1 in sec. 22, T. 18 N., R. 8 W., Osceola County. It made 388,000 cubic feet from the Michigan Stray sand at 1,467 feet. Two additional wells were drilled in 1941.

A well in sec. 7, T. 18 N., R. 7 W., Osceola County, found 1.9 million cubic feet of gas in the Michigan Stray sand at 1,528 feet to open a new producing area. A second well was drilled in 1941.

Four Berea-sand gas wells completed in the Deep River pool in Arenac County at 1,500 to 1,550 feet proved an area of about 800 acres. The largest of these wells made 3.5 million cubic feet a day.

Perhaps the most important gas discovery of 1941 was made by Turner No. 1 in sec. 15, T. 3 S., R. 4 W., Calhoun County, 60 miles from the nearest gas well. A reported daily flow of 10.5 million cubic feet was found in Traverse limestone at 1,609 feet. Closed pressure was about 720 pounds.

Mississippi.—At the end of 1941 the Jackson gas field had 23 producing wells; all but 5 were producing some salt water with the gas. Total gas production in 1941 was 3,878 million cubic feet, a reduction of 39 percent from 1940, according to information supplied by H. M. Morse, supervisor of the Mississippi State Oil and Gas Board.

Of five wells drilled on the Jackson structure during 1941, four were completed as gas wells and one was a dry hole. In addition, a 1940 dry hole was completed as a gas well in January 1941 after it blew in from a depth of about 1,100 feet while casing was being pulled. Nine wells in the field were abandoned during 1941.

The Jackson field continued to yield the only commercial gas production in Mississippi. Casinghead-gas production in the Tinsley oil field is negligible; in fact, gas is piped in for fuel.

Missouri.—Information from Frank C. Greene, geologist, Missouri

Geological Survey, indicates that gas completions and new capacity fell off sharply in 1941 from the 1940 totals. Of the 18 gas wells drilled, 9 were in the Polo field, Caldwell County (a 1940 discovery), and had a total daily open-flow capacity of 4.4 million cubic feet. The Prairie Point field, Platte County, had 5 new wells with total daily capacity of 7.9 million cubic feet; 4 small wells were drilled in Jackson County. No new gas areas were opened.

Montana.—Completion of 59 gas wells in 1941 marked a continued expansion in gas development since the low point in 1938, when only 21 were reported. A report by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo., is the source of information. Only one new well was in wildcat territory; drilled in sec. 18, T. 35 N., R. 4 E., Liberty County, it opened the Haystack Butte field in November 1941, when it flowed 1.3 million cubic feet of gas a day from two sands in the Colorado shale at 1,938 and 2,162 feet.

Twenty-nine wells were drilled at Bowdoin to comply with lease agreements and to prepare for unitization of the field. The Kevin-Sunburst area had 9 gas completions; Cedar Creek had 7. The remainder of the new wells were scattered in other fields.

Marketed production increased 7 percent in 1941 to 27,319,244,000 cubic feet. Production of the Bowdoin field more than doubled, as it supplied a substantial portion of the gas requirements of the pipeline system formerly dependent on Cedar Creek alone. Cedar Creek withdrawals were reduced 12 percent to conserve its gas reserve for future peak loads. The production rates of other fields did not change radically from 1940. It is estimated that 13,214 million cubic feet of gas were used for domestic and commercial purposes (increase, 14 percent) and 14,152 million for industrial purposes (increase, 1 percent).

The two active gasoline plants in Montana processed 7 percent more gas in 1941 than in 1940. The absorption plant at Cut Bank handled 10,565 million cubic feet, from which it extracted over 4 million gallons of natural gasoline and liquefied gases. At the Dry Creek plant, 200 million cubic feet of gas were processed and 59,000 gallons of natural gasoline recovered.

Number of wells and natural gas produced in Montana in 1941, by fields

Field	Number of wells producing gas Dec 31, 1941 [1]	Marketed gas production (M cubic feet) [2]	Gas used for repressuring (M cubic feet) [2]	Estimated field use (M cubic feet) [2]	Estimated waste (M cubic feet) [2]
Bowdoin	93	2,334,855		500	2,000
Bowes	13	577,240			1,000
Box Elder	7	479,393			500
Cedar Creek	159	6,642,516			10,000
Cut Bank	87	11,426,478			100,000
Devon	9	310,664			500
Dry Creek	6	1,060,381			2,000
Hardin	61	82,071			800
Haystack Butte	1	13,152			1,500
Kevin-Sunburst	190	3,408,472	7,200	20,000	18,250
Whitlash	17	984,022			100
Total Montana	643	27,319,244	7,200	20,500	136,650

[1] Compiled by Oil Conservation Board of Montana.
[2] Data supplied by L. G. Snow, acting supervisor, Geological Survey, U. S. Department of the Interior.

New Mexico.—Gas-well completions in southeastern New Mexico in 1941 about doubled the 1940 record in both number and initial capacity, according to information supplied by Foster Morrell, acting supervisor, Geological Survey, United States Department of the Interior, Roswell, N. Mex. Thirteen wells had a total initial daily production of 158.5 million cubic feet.

Gas marketed from the Lea and Eddy County fields totaled 36,472 million cubic feet, 30 percent above the 1940 total. Only about 1 percent of this gas came from Eddy County. The throughput of gasoline plants was 109,756 million cubic feet, a 13-percent gain over 1940. Gas lift, other oil-field uses, and venting without gasoline-plant treatment are estimated to have consumed 19,289 million cubic feet. About 50 billion cubic feet of residue gas presumably were blown to the air. One gas pipe-line company has arranged to market increased volumes of residue gas in future.

A shallow gas discovery was reported in Eddy County in August. The No. 1 Willis in sec. 14, T. 20 S., R. 28 E., made 3 million cubic feet of gas from the Permian at 830 to 930 feet.

In the northwestern part of the State, six gas wells were drilled in 1941 with a total initial capacity of 10.4 million cubic feet. Gas production was 28 percent larger than in 1940 and totaled 3,677 million cubic feet. The output of Fulger Basin increased severalfold in 1941 to 600 million cubic feet. Withdrawals from other fields increased moderately; Kutz Canyon produced 2,053 million cubic feet, Ute Dome 985 million, and Blanco 39 million.

New York.—Drilling for natural gas in the Oriskany sandstone obtained a smaller total of initial production during 1941 for the fourth successive year, according to information supplied by C. A. Hartnagel, State geologist. From a daily peak of 403.4 million cubic feet in 1937, the initial productive capacity has fallen to 91 million in 1941. Of 42 wells drilled in 1941, 18 were producers compared with 1940 totals of 50 and 20, respectively.

Allegany and Steuben Counties continued to lead in development, although Steuben replaced Allegany in 1941 as the area in which nearly all the substantial new production was found. Allegany County slipped badly from 13 wells with 84.6 million cubic feet initial capacity in 1940 to 2 wells with 8.3 million in 1941. Comparable data for Steuben County were 3 wells with 13.6 million cubic feet capacity in 1940 and 14 wells with 82.1 million in 1941. Half of the 42 Oriskany tests drilled during 1941 were in Steuben County. In Cameron Township all five of the wells drilled were successful, and their new daily production totaled 35.8 million cubic feet of gas. Three of five wells drilled in West Union Township came in with a total production of 39.3 million cubic feet. In Howard Township six wells drilled in 1941 were all small producers, but they are closely spaced and the life of the field may be short.

Other exploratory wells to the Oriskany sandstone were drilled in Tompkins, Chemung, and Wyoming Counties; of these, only two in the city of Elmira (Chemung County) gave production, and it was small. As a whole, the known fields producing from the Oriskany sandstone are being rapidly depleted; numerous tests during the last few years have failed to find any important new Oriskany pools. The Wayne-Dundee field, where gas from the Oriskany sandstone was discovered in 1930, is now being used for storage of gas.

North Dakota.—Natural-gas production has been unimportant in the past in North Dakota, but growing interest in exploration by oil companies may presage a more active future. Wilson M. Laird, State geologist, has furnished the following information.

Five gas wells were drilled in 1941 in a southeastern extension of the Cedar Creek (Mont.) field, in the extreme southwestern corner of the State. At the end of 1941, eight small gas wells on the North Dakota side of the State boundary were producing from the "Eagle" sand. They were shut in except for November and December, when 47 million cubic feet of gas were withdrawn. The gas is piped into Montana, where it enters the large pipe-line system that supplies parts of the Dakotas and eastern Montana.

In the Souris River gas area in the vicinity of Mohall, a number of small gas wells have produced for years from the Dakota sandstone, which occurs there at a depth of about 1,000 feet. The gas is used locally in a few homes, as the supply apparently is too small to encourage commercial exploitation. Small amounts of gas are also produced and used locally in an area near La Moure in the southeastern part of the State. It comes from the Dakota sandstone with artesian water.

Ohio.—A 27-percent increase in drilling during 1941 resulted in 43 percent more gas-well completions and a 72-percent increase in volume of initial gas capacity. These ratios indicate a fair degree of success for the intensive efforts to develop more gas in Ohio. Data are taken from a report by Kenneth Cottingham, chief geologist, Ohio Fuel Gas Co. The average initial capacity per well increased from 581,900 cubic feet in 1940 to 702,000 in 1941. Larger average wells were completed in all producing formations except the Trenton, in which activity was negligible.

The Clinton sand continued dominant as a source of gas, with 325 wells averaging 1,092 thousand cubic feet of gas a day. Gas completions in other sands, with average initial daily capacity in thousands of cubic feet, were: Shallow sands 162 with 381 average, Berea 150 with 188, Ohio shale 26 with 191, Oriskany 7 with 432, Newburg 29 with 1,356, and Trenton 2 with 50.

A total of 35 counties—five more than in 1940—reported gas-well completions in 1941. The most active counties, in order, were: Licking 102, Meigs 63, Athens 60, Washington 46, Muskingum 45, Knox 43, Noble 34, and Monroe 31. The sharpest gain in number of wells was in Meigs County.

Four deep tests were drilled through the Trenton limestone. A small show of gas was encountered in one of them in a sandy formation, called the St. Peter, at 3,975 feet in sec. 21, Jersey Township, Licking County.

Clinton-sand development was most active in Licking County, where 91 gas wells were completed, most of them in the area northeast of the city of Newark. Thirty-nine Clinton gas wells were drilled in Knox County and 45 in Muskingum. The largest well of the year in Ohio was Winters No. 1, in sec. 5, Salt Creek Township, Muskingum County, which made 12 million cubic feet from the Clinton sand at 4,123 feet and had a closed pressure of 1,120 pounds. Two other Clinton-sand wells in Muskingum County and two in Morgan County tested 10 million cubic feet or more initially. A Newburg-sand well in Independence Township, Cuyahoga County, yielded 6 million cubic feet a day from a depth of 2,720 feet.

In Washington Township, Harrison County, several Clinton wells were drilled; two of them made producers of 471,000 and 365,000 cubic feet of gas initial daily capacity from depths below 5,800 feet. Another deep well made 559,000 cubic feet of gas from the Clinton sand with total depth of 5,289 feet. It was drilled in sec. 26, Union Township, Tuscarawas County. A number of deep dry holes were drilled in eastern Ohio through the Oriskany or Clinton sands, the deepest going to the Clinton at 7,887 feet in sec. 19, Smith Township, Belmont County; this was the second-deepest hole ever drilled in Ohio.

Oklahoma.—Continued decline in production of natural gas from oil wells caused a 6-percent drop in gas production for 1941 to 254,881 million cubic feet, according to the Oklahoma Tax Commission. A 3-percent increase in production from gas wells to 90,529 million cubic feet was overbalanced by an 11-percent decline in casinghead gas output to 164,352 million cubic feet.

Although drilling for oil and gas increased moderately in Oklahoma in 1941, owing in part to a 30-percent increase in wildcatting ventures, gas-well completions apparently declined slightly to about 175 from about 180 in 1940. Most of the gas wells continued to be drilled in the old eastern areas, led by Muskogee, Okmulgee, Creek, Wagoner, Okfuskee, and Latimer Counties. Nine gas completions were reported in the Chickasha field and 5 at Cement, adding materially to productive capacity of these important fields. One well drilled in eastern Texas County increased the already vast area proved for gas production.

A total of 14 gas discoveries was reported—2 in the Wilcox sand, 3 in the Cromwell, and 1 each in 9 other formations above the Wilcox. By counties they were as follows: Hughes 2, Lincoln 2, Okfuskee 2, and 1 each in Carter, Le Flore, Osage, Pontotoc, Pottawatomie, Seminole, Stevens, and Texas. A new pay formation was found in the Centrahoma area of Coal County when a well in sec. 27, T. 2 N., R. 9 E., made 10.6 million cubic feet a day from a sand at a depth of 1,340 feet.

Gas output of the Oklahoma City field continued to shrink rapidly as pressures in several sands declined below pipe-line intake pressures. The oil operators who blew many billions of cubic feet of gas to the air to produce oil as rapidly as possible now regret the current absence of a vast quantity of natural gas at low prices such as would make repressuring profitable.

The volume of gas piped from Oklahoma fields to markets to the north and east probably was 10 percent larger in 1941 than in 1940, due chiefly to increased takings from the Chickasha-Cement district and from Texas County.

Pennsylvania.—The outstanding trend during 1941 in Pennsylvania gas fields was intensification of development in shallow-sand territory, according to information from J. G. Montgomery, Jr., vice president, United Natural Gas Co. This was the natural result of increased gas demand from war-stimulated industry and the foreshadowed exhaustion of the northern Oriskany sand fields.

The active drilling campaign resulted in several discoveries; the most important was probably the Armbrust pool in Westmoreland County, where about 600 acres were proved for Fifth-sand gas production, with the limits of the pool still undefined. Average initial open-flow capacity of the wells was 780,000 cubic feet and reservoir pressure

1,015 pounds at the year end. *Fifteen* wells had been completed by the end of 1941, and 24 more were being drilled.

In East Franklin and Sugar Creek Townships, Armstrong County, a small gas pool was discovered in the Hundred Foot sand. A Kane sand well in Oliver Township, Jefferson County, completed for an initial daily production of over 2 million cubic feet, spurred activity in that region. In western Fayette and eastern Greene Counties a number of wells with an initial daily open-flow capacity of 1 to 5 million cubic feet were completed in the Big Injun sand and Mississippian. A well in Forward Township, Allegheny County, made 9 million cubic feet a day from the Bayard sand of the Upper Devonian. The smaller capacity of wells drilled recently in the Sliverville pool, McKean County, formerly prolific in gas as well as oil, indicates that it is nearing exhaustion.

Commercial exploitation of gas from the shallow Portage shales of western Erie County was attempted. Initial daily volumes varied widely but averaged about 900,000 cubic feet.

Oriskany-sand development resulted in one small discovery and extension of the producing area of one field. The discovery well in Bingham Township, Potter County, made about 1 million cubic feet of gas a day from the Oriskany sand. Five scattered dry holes were drilled to this sand in the Potter-Tioga Counties district. The Summit gas pool, Fayette County, was extended 1 mile southwestward with the completion of three wells in South Union Township. Their initial daily capacities were 1, 2, and 3 million cubic feet from the Chert zone of the Onondaga formation and the underlying Oriskany sandstone. Three more wells were being drilled in the field. In Stewart Township the deepest test ever drilled in Pennsylvania shut down at 8,498 feet after encountering only 16,000 cubic feet of gas in the Oriskany.

Three Oriskany exploratory wells, drilled respectively in North Sewickley Township (Beaver County), Springfield Township (Mercer County), and West Franklin Township (Armstrong County), were completed as dry holes; the last two holes did not encounter the Oriskany sandstone. Other Oriskany tests were being drilled in Greene, Beaver, and Westmoreland Counties.

A small show of gas was found in the St. Peter sandstone in a well in Springfield Township, Erie County, which penetrated this formation in Pennsylvania for the first time.

Gas production from shallow sands increased greatly during 1941, whereas Oriskany-sand production from the Potter-Tioga Counties fields continued its decline from 6.5 billion cubic feet in 1940 to 3.75 billion in 1941.

Blow-outs due to high-pressure gas pockets in the Marcellus shale were overcome at the Beaver County Oriskany test by drilling a pilot hole ahead of the larger tools and then reaming. Other operators have carried a column of brine in the hole to combat this nuisance.

South Dakota.—No wells were drilled in South Dakota during 1941, according to information from E. P. Rothrock, State geologist. The small gas production at Pierre and Fort Pierre continued to be separated from artesian water and marketed locally.

Geological and geophysical prospecting by major oil companies continued in 1941. Large areas are under lease in central and extreme western South Dakota, and some wildcat drilling may be attempted in the spring of 1942.

Tennessee.—Kendall E. Born, assistant geologist, Department of Conservation, Nashville, Tenn., reports that natural gas is marketed from producing leases in two areas in Tennessee—Sunbright in northern Morgan County and Jamestown in Fentress County.

A small volume of gas is obtained from oil wells 5 miles northwest of Sunbright which produce from beds of lower Mississippian age at 1,150 to 1,400 feet. A 2-inch pipe line serves the small community.

Four shallow wells about 3 miles south of Jamestown produce gas from fractured limestones of Trenton age. The gas was piped into Jamestown about 2 years ago, but no production figures are available.

Texas.—Gross gas production in Texas continued its upward trend to new high levels in 1941 to total about 1,740 billion cubic feet, as estimated from incomplete State reports. Gas wells are thought to have produced about 1,200 billion and oil wells 540 billion cubic feet.

As in 1940, operations of cycling plants in condensate fields expanded rapidly (30 percent); about 420 billion cubic feet of gas were processed, accounting for the increase in gas-well output. During November and December 1941, recycling plants returned an average of 1,200 million cubic feet of gas a day to producing formations under high pressures, and the total daily intake volume of these plants slightly exceeded 1,400 million cubic feet. The average yield of petroleum liquids of all types from these plants was about 1.1 gallons per thousand cubic feet of gas processed. At the end of 1941, 280 producing wells were connected to recycling plants, an increase of 37 during the year.

Gas-well completions reported totaled 294 in 1941, an increase of 5 over 1940. Panhandle completions slumped from 81 in 1940 to 49 in 1941, and Eastern Texas completions were off slightly from 59 to 54. Modest gains were reported in other areas, led by Southwest Texas with 18 more gas wells to a total of 88 in 1941 and North Central Texas with a gain of 17 to 54.

In 1941, 23 gas and condensate discoveries were reported, comprising 8 condensate producers and 15 dry gas wells. The Eastern Texas district had 3 condensate discoveries—Pleasant Grove, Rusk County; Willow Springs, Gregg County; and Grosbeck, Limestone County. These fields produce from the Woodbine, Rodessa, and Pettit formations, respectively. In the Hawkins field, Wood County, a substantial gas reserve was indicated in the sub-Clarksville sand just above the Woodbine oil sand.

In North Texas a single gas discovery was made by No. 1 Mosely, which produced 2.2 million cubic feet of gas from the Bend series at 4,498 to 4,510 feet.

On the Gulf coast, condensate discoveries were reported at Needville in Fort Bend County and Vienna in Lavaca County, producing from the Frio and Wilcox formations. A gas area was opened at Navidad, Jackson County, by No. 1 Terrell, which found pay in the Frio at 3,786 to 3,793 feet.

Of seven discoveries listed in Southwest Texas, five produced from the Jackson formation. Two of these were condensate wells at Genevieve, Bee County, and Rios, Duval County. Dry gas discoveries were made at Chaparosa and East Colorado, Jim Hogg County, and Heard, Bee County. A Frio sand condensate discovery was made at Coloma Creek, Calhoun County; and at Steamboat Pass, also in Calhoun, a well made 32 million cubic feet of gas from the Catahoula at 2,880 to 2,885 feet.

In West Texas a wildcat produced 2 million cubic feet ot gas from a limestone at 1,250 feet at Baldwin in Menard County.

Eight dry-gas discoveries were reported in West Central Texas. Largest initial capacity was from the No. 1 Hendricks, which made 13 million cubic feet a day from the Cisco at 1,476 to 1,489 feet to open the Crites pool in Haskell County. In Stevens County an unnamed pool was opened by No. 1 Wheland, which made 10.5 million cubic feet of gas from the Marble Falls limestone at 4,077 to 4,095 feet, and the Loving pool was discovered by No. 1 Walls Pasture Co., which found 1.2 million cubic feet in the lower Caddo lime at 4,069 to 4,082 feet. Other discoveries were: Kirk pool in Eastland County and Greynolds pool in Brown County which produced from the Caddo lime, the Elliott pool in Shackelford County which made gas from the Canyon limestone, the Silver Valley pool in Coleman County which produced from the Fry sand (Strawn), and the Noland pool in Palo Pinto County which produced from the Strawn series.

Utah.—Production of natural gas increased 9 percent in 1941 to 4,705 million cubic feet, as reported by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. The Ashley Valley field, which furnished the only commercial gas production in Utah in addition to the Clay Basin field, was exhausted after producing only 15 million cubic feet in 1941. The wells were being abandoned and materials salvaged at the year end. The Last Chance gas field, with one well available, remains shut in because of its isolated location and unknown reserves.

At Farnham 102 million cubic feet of carbon dioxide were taken from one well and used in the manufacture of dry ice.

The only new gas well in the State in 1941 was completed in the Clay Basin field, with an initial daily capacity of 19.2 million cubic feet. Clay Basin has been operated under a unit agreement since January 1, 1940. It now has seven gas wells in the Dakota sand and two in the Frontier, which is not very productive. One Dakota well to each 600 acres is deemed to be productive.

Washington.—Unofficial reports indicate that natural-gas production in Washington ended in August or September 1941 with the shutting down of the depleted Rattlesnake Hills field and capping of the wells. Butane or propane gas probably was substituted for natural to meet obligations to customers in the Yakima Valley towns that have been served.

West Virginia.—Exploration and development continued to expand vigorously during 1941 as current and prospective demand for gas threatened to exceed the supply "in sight." Information is taken from a report by David B. Reger, consulting geologist, Morgantown, W. Va.

Reported new gas wells increased 19 percent to 558 in 1941. Total new daily capacity developed was 1,005 million cubic feet—including 56 million from 86 old wells deepened—almost 50 percent larger than the 1940 volume.

About 75 percent of the initial capacity added in 1941 was from the Oriskany sand, in which 166 gas wells were completed. Jackson supplanted Kanawha as the most active county, with 94 new Oriskany gas wells having a total initial daily capacity of 545 million cubic feet. About 14,800 additional acres were proved for Oriskany gas production in the Buttermilk-Sandyville gas pool. raising its total proved

territory to 16,000 acres. In Kanawha County, 68 Oriskany wells had 170.5 million cubic feet of initial daily capacity, averaging much smaller in size than the Jackson County wells. About 20,000 acres were added to the proved area of the Elk-Poca pool, making its total extent at the end of 1941 80,000 acres. The four Oriskany sand pools in the Charleston district now cover about 107,000 acres whose estimated original gas reserve in the Oriskany sand was approximately 600 billion cubic feet. Recovery thus far has been about 350 billion cubic feet, leaving an estimated supply of 250 billion available for consumption at the beginning of 1942.

Two Oriskany wells were completed in the Union district, Putnam County, on the west edge of the Elk-Poca gas pool. A successful wildcat in Lewis County, Freeman's Creek district, was completed with rotary tools in the Oriskany at a reported total depth of 7,325 feet. The open-flow capacity was 474,000 cubic feet and closed pressure 2,300 pounds. Oriskany sand failures were drilled in Boone, Harrison, Lincoln, Monongalia, Roane, and Wood Counties. The White Clinton sand was tested unsuccessfully in Harrison County, Grand district, by a rotary-drilled well that went to the record depth of 10,018 feet without finding commercial quantities of gas. Two dry holes through the Clinton were drilled in Kanawha County and one in Wood County.

The Trace Fork gas pool in the Curry district, Putnam County, was the most actively developed shallow-sand area in 1941. In all, 38 gas wells were drilled with a total daily open-flow capacity of over 30 million cubic feet. The proved area of the field was enlarged from 10,000 to 15,000 acres during 1941, most production coming from Salt sand, Big Lime, and Berea. Only a few wells have been drilled to the Devonian brown shale, which may eventually furnish much additional gas in this pool.

The total gas production in 1941 is estimated to have increased to 210 billion cubic feet.

Leading counties in gas-well completions were: Boone 32, Braxton 19, Cabell 16, Calhoun 46, Clay 20, Gilmer 37, Jackson 94, Kanawha 82, Lincoln 17, Putnam 46, Ritchie 33, Upshur 20, and Wayne 33.

Wyoming.—Five gas wells were drilled in old fields during 1941—one each at Bunker Hill, East Allen Lake, Elk Basin, Hiawatha, and Muskrat. The total daily open-flow capacity was 56.4 million cubic feet. Information is taken from a summary by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. The Elk Basin well was a field extension; the others were within the probable limits of fields previously established.

Three gas discoveries were made. A small well was drilled in sec. 10, T. 12 N., R. 101 W., at Canyon Creek, Sweetwater County, near an old and deeper dry hole. A wildcat well in sec. 31, T. 25 N., R. 88 W., on Sherard dome tested 5.8 million cubic feet from the Dakota and Lakota sands. It was continued unsuccessfully to the Tensleep formation in search of oil. A well in sec. 10, T. 29 N., R. 113 W., at Big Piney reported 15 million cubic feet of gas at a depth of 950 feet. Several good gas showings have been encountered in this area, but it is remote from existing gas lines or consuming centers.

The gross gas production increased 11 percent in 1941 to 43.4 billion

cubic feet, and metered or marketed production was 4 percent larger at 28.3 billion. Gas used in cycling or repressuring was 10.9 billion cubic feet in 1940 and 12.5 billion in 1941. The Salt Lake City gas system took 14.8 billion cubic feet of gas during 1941, an increase of 13 percent over 1940.

As a rule production was moderately higher in the principal fields, a notable exception being Big Medicine Bow, where a decline of over 50 percent was reported. Gas output of some larger fields in 1941 was as follows: Salt Creek 9,509 million cubic feet, Baxter Basin (entire field) 6,949 million, Lance Creek 7,294 million, Big Sand Draw 4,773 million, Muskrat 2,114 million, Little Buffalo Basin 1,737 million, Elk Basin 1,793 million, and Big Medicine Bow 584 million.

Salt Creek and Lance Creek continued to be the only fields where repressuring or pressure maintenance is being carried out on a large scale. The volume of gas injected in these fields totaled 6.4 and 4.8 billion cubic feet, respectively, in 1941. Small amounts also were returned to formations at Elk Basin, La Barge, Rock Creek, Wertz, and Grass Creek.

Gasoline plants processed 22,366 million cubic feet of gas in 1941, distributed by fields as follows, in millions of cubic feet: Salt Creek 9,466, Lance Creek 7,230, and Big Sand Draw 4,773, with small amounts at Rock Creek, Elk Basin, and Grass Creek.

CONSUMPTION

Consumption of natural gas in the United States in 1940 was the largest on record, increasing 7 percent over 1939 to 2,655 billion cubic feet. Domestic and commercial demand rose 13 percent—an unusual gain—owing to extremely cold weather in January and February 1940. The industrial load was higher than in 1939 by a modest 6 percent, as all types of demand expanded except that of fuel for electric power plants.

The average unit sales value of domestic and commercial gas has trended slightly downward since 1932. The number of meters has grown rapidly (42 percent), while the average consumption per meter has shown no definite trend, apparently responding chiefly to variations in weather conditions.

In the 8 years following 1932 the demand for natural gas more than doubled in each of 20 States, and total consumption increased 71 per-

Natural gas consumed in the United States, 1936–40

Year	Domestic and commercial consumption							Average value at points of consumption per M cubic feet (cents)
	Consumers (thousands)[1]			Billions of cubic feet			Average number of M cubic feet used per domestic and commercial consumer	
	Domestic	Commercial	Total	Domestic	Commercial	Total		
1936	8,017	657	8,674	343	112	455	52.5	67.1
1937	8,348	680	9,028	372	117	489	54.2	67.6
1938	8,570	695	9,265	368	114	482	52.0	68.3
1939	8,888	715	9,603	391	119	510	53.1	67.9
1940	9,245	741	9,986	444	134	578	57.9	65.7

[1] Includes consumers served with mixed gas.

Natural gas consumed in the United States, 1936–40—Continued

Year	Industrial consumption								Total consumption	
	Billions of cubic feet							Average value at points of consumption per M cubic feet (cents)	Billions of cubic feet	Average value at points of consumption per M cubic feet (cents)
	Field	Carbon-black manufacture	Petroleum refineries	Electric public-utility power plants [1]	Portland-cement plants [2]	Other industrial	Total industrial			
1936	619	283	93	156	37	518	1,706	10.0	2,161	22.0
1937	651	341	113	171	41	597	1,914	10.3	2,403	22.0
1938	659	325	110	170	37	511	1,812	9.4	2,294	21.8
1939	681	347	98	191	40	607	1,964	9.6	2,474	21.6
1940	712	369	128	183	42	643	2,077	9.5	2,655	21.7

[1] Federal Power Commission.
[2] Chapters on Cement in Minerals Yearbook.

Natural gas consumed in the United States, 1936–40, by States, in millions of cubic feet

State	1936	1937	1938	1939	1940
Alabama	16,630	16,593	14,796	20,093	23,461
Arizona	8,232	12,857	12,660	16,643	18,002
Arkansas	30,986	35,074	34,833	35,673	39,719
California	320,406	329,769	315,168	348,361	351,950
Colorado	19,713	20,816	19,212	21,978	22,111
District of Columbia	3,104	3,458	3,826	4,069	4,686
Florida	1,005	1,389	1,469	1,658	1,481
Georgia	11,575	13,893	14,783	16,296	20,551
Illinois	72,516	78,650	66,500	77,134	88,088
Indiana	18,564	23,551	26,706	30,795	29,214
Iowa	20,918	21,354	20,109	21,732	23,460
Kansas	82,025	96,822	86,105	85,865	96,772
Kentucky	18,159	18,154	15,350	16,563	18,881
Louisiana	166,485	174,153	162,260	164,667	185,089
Maryland	915	1,011	1,247	4,907	5,855
Michigan	11,142	24,112	24,697	27,316	32,790
Minnesota	11,918	13,111	14,641	17,262	19,904
Mississippi	11,368	13,327	12,785	14,207	17,657
Missouri	40,124	46,898	42,505	47,157	53,141
Montana	[1] 19,894	[1] 21,594	[1] 18,225	[1] 19,765	22,328
Nebraska	16,780	17,263	17,539	19,654	20,087
New Mexico	19,814	28,056	32,890	38,981	40,198
New York	40,638	50,080	47,950	46,877	27,250
North Dakota	1,578	1,641	1,533	1,607	1,725
Ohio	121,381	125,133	108,013	114,720	129,856
Oklahoma	260,120	269,604	244,443	231,005	230,806
Pennsylvania	110,195	119,501	96,285	109,746	121,230
South Dakota	5,061	5,519	5,354	5,712	6,454
Tennessee	11,913	13,353	14,047	[2] 15,558	16,819
Texas	598,088	706,120	729,603	796,561	874,294
Utah	10,552	12,449	11,699	13,172	14,802
Virginia	447	550	615	[2] 788	963
Washington	141	143	117	63	36
West Virginia	57,978	65,395	57,478	69,394	77,540
Wyoming	20,153	21,648	18,654	17,786	17,459
Total United States	2,160,518	2,403,041	2,294,097	2,473,765	2,654,659

[1] Includes natural gas piped from Canada.
[2] Small amount of gas consumed in Tennessee included with Virginia; separate figures not available.

cent. The gain of 460 billion cubic feet in Texas overshadowed that in other States from the standpoint of total volume; other important gains were in California, Louisiana, Illinois, Pennsylvania, and Kansas. Upon a percentage basis, the sharpest increases were in Michi-

gan, Minnesota, Maryland, Arizona, and Georgia; major gas lines have been laid to all those States since 1928 to open up new market areas.

Treated for natural gasoline.—Continued growth in recycling-plant operations in the Gulf Coast region was the major factor in an estimated 17-percent increase in volume of gas treated for gasoline extraction in the United States in 1941 to about 2,900 billion cubic feet. The continued decline in gasoline yield evidenced during 1941 is suggested by natural-gasoline production statistics, which indicate small reductions in the output of such important States as California and Oklahoma, where yields are above the national average, and pronounced gains in Texas and Louisiana, where yields are below the national average.

Final data indicate that in 1940 the volume of gas processed exceeded that in 1939 by 15 percent. The largest gains over 1939 were in Texas, Louisiana, West Virginia, Pennsylvania, and Illinois.

Natural gas treated at natural-gasoline plants in the United States, 1936–40, by States, in millions of cubic feet

State	1936	1937	1938	1939	1940
Arkansas	2,955	4,031	21,377	19,171	26,584
California	372,118	381,568	398,187	377,041	375,407
Colorado	223	153	145	130	142
Illinois	971	1,027	1,110	2,440	12,716
Kansas	106,230	153,416	144,631	141,945	150,963
Kentucky	35,493	34,981	38,446	36,817	39,662
Louisiana	115,606	144,474	116,331	114,960	145,234
Michigan	1,419	1,381	1,395	1,019	1,414
Montana	8,238	9,062	7,126	8,116	9,528
New Mexico	29,489	61,625	97,830	97,010	101,213
New York	22	50	65	65	40
Ohio	33,103	33,625	28,488	32,703	38,547
Oklahoma	255,433	338,007	265,746	219,755	219,255
Pennsylvania	34,168	31,508	22,600	26,662	40,161
Texas	673,483	754,696	752,784	914,701	1,123,236
West Virginia	128,488	140,512	122,301	140,982	168,206
Wyoming	17,561	18,684	17,000	16,483	19,092
	1,815,000	2,108,800	2,035,562	2,150,000	2,471,400
Percent of total consumption	84	88	89	87	93

Domestic and commercial.—Consumption of natural gas by domestic and commercial customers was notably lower during the early months of 1941 than in the corresponding 1940 period in all districts except California, because higher average temperatures prevailed. Unseasonably warm weather throughout the fall and early winter of 1941 in the Appalachian region curtailed the retail distribution of gas somewhat below normal expectancy. Therefore, domestic consumption is estimated to have increased less than 1 percent to 447 billion cubic feet in 1941 despite sharply increased national income and more domestic meters in use. Commercial use of gas increased 6 percent in 1941 to a new peak of about 143 billion cubic feet.

The average revenue received in 1941 per thousand cubic feet for gas sold is thought to have declined slightly to 70.8 cents from domestic consumers and 47.4 cents from commercial consumers. In 1940 the average value of domestic and commercial gas declined in all the larger consuming States except Pennsylvania, where a 6-percent increase was reported, probably reflecting a tight sellers' market for gas in the producing fields.

Domestic and commercial consumption of natural gas in the United States in 1940, by States [1]

State	Domestic: Consumers	Domestic: M cubic feet	Domestic: Value at points of consumption: Total	Domestic: Value at points of consumption: Average (cents)	Commercial: Consumers	Commercial: M cubic feet	Commercial: Value at points of consumption: Total	Commercial: Value at points of consumption: Average (cents)	Total: Consumers	Total: M cubic feet	Total: Value at points of consumption: Total	Total: Value at points of consumption: Average (cents)
Alabama	33,390	1,867,000	$1,856,000	99.4	3,890	789,000	$410,000	52.0	37,280	2,656,000	$2,266,000	85.3
Arizona	36,860	1,219,000	1,559,000	127.9	3,890	785,000	460,000	58.6	40,750	2,004,000	2,019,000	100.7
Arkansas	71,960	6,515,000	3,264,000	50.1	12,350	3,683,000	1,251,000	34.0	84,310	10,198,000	4,515,000	44.3
California	1,693,490	74,795,000	56,994,000	76.2	92,890	17,335,000	8,566,000	49.4	1,786,380	92,130,000	65,560,000	71.2
Colorado	97,750	6,073,000	4,726,000	77.8	9,820	1,887,000	1,085,000	57.5	107,570	7,960,000	5,811,000	73.0
District of Columbia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	4,130	148,000	197,000	133.1	470	52,000	43,000	82.7	4,600	200,000	240,000	120.0
Georgia	86,160	5,455,000	4,607,000	84.5	7,650	3,080,000	1,135,000	36.9	93,810	8,535,000	5,742,000	67.3
Illinois	1,237,020	19,269,000	23,634,000	122.7	65,920	5,179,000	4,547,000	87.8	1,302,940	24,448,000	28,181,000	115.3
Indiana	148,200	3,346,000	3,791,000	113.3	8,790	775,000	678,000	87.5	156,990	4,121,000	4,469,000	108.4
Iowa	132,550	5,034,000	4,997,000	99.3	10,690	1,470,000	1,012,000	68.8	143,240	6,504,000	6,009,000	92.4
Kansas	214,140	18,484,000	10,805,000	58.5	27,000	9,422,000	3,103,000	32.9	241,140	27,906,000	13,908,000	49.8
Kentucky	172,450	9,769,000	5,529,000	56.6	17,310	2,430,000	1,208,000	49.7	189,760	12,199,000	6,737,000	55.2
Louisiana	191,840	10,656,000	7,405,000	69.5	22,190	5,790,000	2,262,000	39.1	214,030	16,446,000	9,667,000	58.8
Maryland	[2] 224,770	[2] 5,659,000	[2] 4,340,000	[2] 76.7	[2] 10,540	[2] 717,000	[2] 482,000	[2] 67.2	[2] 235,310	[2] 6,376,000	[2] 4,822,000	[2] 75.6
Michigan	572,580	20,406,000	21,096,000	103.4	24,210	2,825,000	2,725,000	96.5	596,790	23,231,000	23,821,000	102.5
Minnesota	159,690	5,438,000	4,938,000	90.8	8,040	2,409,000	1,035,000	43.0	167,730	7,847,000	5,973,000	76.1
Mississippi	49,020	4,046,000	2,649,000	65.5	7,660	2,498,000	864,000	34.6	56,680	6,544,000	3,513,000	53.7
Missouri	386,000	13,624,000	11,571,000	84.9	36,470	4,066,000	2,470,000	60.7	422,470	17,690,000	14,041,000	79.4
Montana	44,740	6,178,000	2,868,000	46.4	5,290	3,750,000	1,098,000	29.3	50,030	9,928,000	3,966,000	39.9
Nebraska	120,650	5,532,000	4,185,000	75.7	8,480	1,593,000	901,000	56.6	129,130	7,125,000	5,086,000	71.4
New Mexico	26,900	2,196,000	1,536,000	69.9	3,290	1,418,000	538,000	37.9	30,190	3,614,000	2,074,000	57.4
New York	410,730	16,934,000	13,558,000	80.1	36,210	3,326,000	2,403,000	72.2	446,940	20,260,000	15,961,000	78.8
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	1,220,880	65,842,000	42,085,000	63.9	115,030	13,456,000	7,417,000	55.1	1,335,910	79,298,000	49,502,000	62.4
Oklahoma	256,820	23,746,000	10,749,000	45.3	33,070	9,938,000	3,107,000	31.3	289,890	33,684,000	13,856,000	41.1
Pennsylvania	691,510	40,132,000	24,559,000	61.2	58,020	8,704,000	4,600,000	52.8	749,530	48,836,000	29,159,000	59.7
South Dakota	16,960	1,289,000	989,000	76.7	1,970	1,233,000	517,000	41.9	18,930	2,522,000	1,506,000	59.7
Tennessee	49,750	3,435,000	2,571,000	74.8	7,190	2,611,000	1,005,900	38.5	56,940	6,046,000	3,576,900	59.2
Texas	648,800	39,714,000	27,520,000	69.3	77,500	15,122,000	6,721,000	44.4	726,300	54,836,000	34,241,000	62.4
Utah	[3] 31,930	[3] 2,720,000	[3] 1,861,000	[3] 68.4	[3] 1,570	[3] 996,000	[3] 346,100	[3] 34.7	[3] 33,500	[3] 3,716,000	[3] 2,207,100	[3] 59.4
Virginia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
West Virginia	191,530	21,116,000	7,674,000	36.3	20,780	5,642,000	1,872,000	33.2	212,310	26,758,000	9,546,000	35.7
Wyoming	22,030	3,009,000	1,402,000	46.6	2,840	1,663,000	537,000	32.2	24,870	4,672,000	1,939,000	41.5
Total: 1940	9,245,230	443,646,000	315,515,000	71.1	741,020	134,644,000	64,399,000	47.8	9,986,250	578,290,000	379,914,000	65.7
1939	8,887,460	391,153,000	287,600,000	73.5	715,390	118,334,000	58,494,000	49.4	9,602,850	509,487,000	346,094,000	67.9

[1] Includes natural gas used with manufactured gas. [2] Maryland includes District of Columbia and Virginia. [3] Utah includes North Dakota and Washington.

Field.—The reported field use of gas during 1941 is estimated to have decreased rather abruptly to 640 billion cubic feet from 712 billion in 1940, in consequence of a drop in consumption in Texas and Oklahoma. The 5-percent gain in 1940 field use of gas reported over 1939 can be ascribed almost entirely to Texas. The total for all other States was little changed, a decline in Oklahoma being balanced by small increases in a number of other States. Illinois had an exceptional increase from 2.2 billion cubic feet in 1939 to 7.8 billion in 1940, influenced by a boom in oil production.

The field-gas volumes in past years probably have experienced some inflation, particularly in Texas and Oklahoma. The questionnaire on which gas operations are currently reported defines more specifically the several types of gas utilization in the field, and it is anticipated that its effect will be to facilitate the construction of reports that will picture with increasing accuracy the actual functions gas performs.

Carbon-black manufacture.—Although carbon-black production increased about 4 percent in 1941, the quantity of gas used in its manufacture was slightly reduced to 365 billion cubic feet from 369 billion in 1940. The average yield of black per thousand cubic feet of gas burned rose to a new high of over 1.6 pounds. A trend to higher yields has been evident for several years, due to rapid growth in the production of furnace blacks, for which the yields are several times the average.

Petroleum refineries.—Consumption of natural gas as fuel at petroleum refineries increased 31 percent in 1940 over 1939 to 128 billion cubic feet, as this fuel supplied 17.1 percent of total heat requirements compared with 14.9 percent in 1939.[3]

Two principal trends encouraged the replacement of other fuels with natural gas in the Southwestern States. First, increasing quantities of refinery vapors formerly used as fuel are now utilized in production of "light-end" liquid petroleum products. Second, an upward trend in the market price of heavy fuel oil in 1940 and 1941 caused some diversion of this product from use as refinery fuel to sale on the open market. A further increase in use of natural gas as refinery fuel is estimated to have occurred in 1941, as it rose to 150 billion cubic feet, a new high.

Electric public-utility power plants.—Preliminary data indicate that 11 percent more natural gas was used at power plants in 1941 than in 1940—203,323 million cubic feet in 1941.

In 1940 such consumption dropped sharply in California as hydroelectric plants resumed normal operation after a severe drought. In New York, failing gas supplies virtually eliminated power plants as consumers. Consumption was lower also in the Illinois-Indiana-Ohio district and in Pennsylvania. Increases were general in areas of abundant gas supplies.

Portland-cement plants.—An unusually large increase (29 percent) in consumption of natural gas as fuel in portland-cement manufacture occurred in 1941 over 1940. The total consumed was 54,208 million cubic feet—a new high. Larger volumes of gas were used in all the chief consuming States, as cement production increased 26 percent over 1940.

[3] Hopkins, G. R., Survey of Fuel Consumption at Refineries in 1940: Bureau of Mines Rept. of Investigations 3607, 1941, p. 2.

Industrial consumption of natural gas in the United States in 1940, by States and uses

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture			Fuel at petroleum refineries, electric public-utility power plants, portland-cement plants, and other industrial							Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet					Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland-cement plants	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Alabama							913,000	(1)	[1] 19,892,000	20,805,000	$3,528,000	17.0	20,805,000	$3,528,000	17.0
Arizona							2,915,000		13,083,000	15,998,000	3,234,000	20.2	15,998,000	3,234,000	20.2
Arkansas	10,762,000	$681,000				4,627,000	2,221,000	(1)	[1] 11,911,000	18,759,000	2,048,000	10.9	29,521,000	2,729,000	9.2
California	133,189,000	7,540,000				18,975,000	13,967,000	8,319,000	85,370,000	126,631,000	16,906,000	13.4	259,820,000	24,446,000	9.4
Colorado	278,000	17,000				1,000	725,000	(1)	[1] 13,147,000	13,873,000	2,167,000	15.6	14,151,000	2,184,000	15.4
District of Columbia									(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida									1,281,000	1,281,000	209,000	16.3	1,281,000	209,000	16.3
Georgia							4,745,000	(1)	[1] 7,271,000	12,016,000	2,125,000	17.7	12,016,000	2,125,000	17.7
Illinois	7,825,000	246,000				197,000	3,326,000		52,292,000	55,815,000	11,805,000	21.2	63,640,000	12,051,000	18.9
Indiana	243,000	10,000					8,599,000		16,251,000	24,850,000	5,580,000	22.5	25,093,000	5,590,000	22.3
Iowa							5,459,000	(1)	[1] 11,497,000	16,956,000	2,602,000	15.3	16,956,000	2,602,000	15.3
Kansas	17,309,000	941,000	(3)	(3)	(3)	2,334,000	17,363,000	5,750,000	[3] 26,110,000	[3] 51,557,000	[3] 6,208,000	[3] 12.0	68,866,000	7,149,000	10.4
Kentucky	1,305,000	178,000				1,000			5,376,000	5,377,000	1,518,000	28.2	6,682,000	1,696,000	25.4
Louisiana	40,717,000	1,621,000	22,599,000	$706,000	3.1	20,079,000	26,246,000	(1)	[1] 59,002,000	105,327,000	10,765,000	10.2	168,643,000	13,092,000	7.8
Maryland									[2] 5,128,000	[2] 5,128,000	[2] 1,448,000	[2] 28.2	[2] 5,128,000	[2] 1,448,000	[2] 28.2
Michigan	1,492,000	102,000				190,000	18,000		7,859,000	8,067,000	4,324,000	53.6	9,559,000	4,426,000	46.3
Minnesota							2,294,000		9,763,000	12,057,000	2,303,000	19.1	12,057,000	2,303,000	19.1
Mississippi	1,042,000	51,000					967,000		9,104,000	10,071,000	1,537,000	15.3	11,113,000	1,588,000	14.3
Missouri	523,000	45,000					10,759,000	(1)	[1] 24,169,000	34,928,000	6,111,000	17.5	35,451,000	6,156,000	17.4
Montana	1,252,000	81,000				728,000	905,000		9,515,000	11,148,000	1,525,000	13.7	12,400,000	1,606,000	13.0
Nebraska							5,835,000	(1)	[1] 7,127,000	12,962,000	2,244,000	17.3	12,962,000	2,244,000	17.3
New Mexico	22,734,000	476,000				47,000	4,458,000		9,345,000	13,850,000	2,083,000	15.0	36,584,000	2,559,000	7.0
New York	446,000	113,000				134,000	55,000		6,355,000	6,544,000	2,884,000	44.1	6,990,000	2,997,000	42.9
North Dakota							(4)		(4)	(4)	(4)	(4)	(4)	(4)	(4)
Ohio	1,323,000	221,500				1,000	968,000		48,266,000	49,235,000	16,984,000	34.5	50,558,000	17,205,500	34.0
Oklahoma	133,771,000	3,150,500	(3)	(3)	(3)	9,580,000	11,867,000	(1)	[1,3] 41,904,000	[3] 63,351,000	[3] 5,289,000	[3] 8.3	197,122,000	8,439,500	4.3
Pennsylvania	6,074,000	1,544,000				1,012,000	406,000		64,902,000	66,320,000	19,753,000	29.8	72,394,000	21,297,000	29.4
South Dakota							1,210,000	(1)	[1] 2,722,000	3,932,000	704,000	17.9	3,932,000	704,000	17.9
Tennessee	1,000	100				1,000	4,511,000		6,260,000	10,772,000	1,848,000	17.2	10,773,000	1,848,100	17.2

See footnotes at end of table.

Industrial consumption of natural gas in the United States in 1940, by States and uses—Continued

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture			Fuel at petroleum refineries, electric public-utility power plants, portland-cement plants, and other industrial							Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet					Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland-cement plants	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Texas	310,426,000	$7,542,000	330,683,000	$2,747,000	0.8	66,398,000	51,316,000	10,038,000	50,597,000	178,349,000	$19,014,000	10.7	819,458,000	$29,303,000	3.6
Utah	47,000	1,900				14,000	[4] 251,000		[4] 12,535,000	[4] 12,800,000	[4] 1,571,000	[4] 12.3	[4] 12,847,000	[4] 1,572,900	[4] 12.2
Virginia									(2)	(2)	(2)	(2)	(2)	(2)	(2)
West Virginia	13,599,000	2,332,000				432,000	72,000		36,679,000	37,183,000	7,510,000	20.2	50,782,000	9,842,000	19.4
Wyoming	7,503,000	264,000				3,256,000	785,000		1,243,000	5,284,000	652,000	12.3	12,787,000	916,000	7.2
Miscellaneous			[3] 15,520,000	[3] 249,000	[3] 1.6			[1] 17,842,000							
Total 1940	711,861,000	27,158,000	368,802,000	3,702,000	1.0	128,007,000	183,150,000	41,949,000	642,594,000	995,706,000	166,230,000	16.7	2,076,369,000	197,090,000	9.5
1939	680,884,000	28,610,000	347,270,000	3,263,000	.9	97,685,000	191,131,000	40,233,000	607,075,000	936,124,000	155,754,000	16.6	1,964,278,000	187,627,000	9.6

[1] Gas used in portland-cement plants included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[2] Maryland includes District of Columbia and Virginia

[3] Gas used in carbon-black manufacture included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[4] Utah includes North Dakota

Other industrial.—The demand for natural gas from miscellaneous industry is estimated to have increased 18 percent in 1941, rising to 760 billion cubic feet as the Federal Reserve Board index of industrial production rose from 136 for December 1940 to 163 for December 1941. Apparently this type of industrial use exceeded for the first time the volume of gas used in oil- and gas-field operations to become the most important class of natural-gas utilization from the standpoint of volume.

The demand from "Other industrial" had attained a new peak in 1940 at 642,594 million cubic feet, or 6 percent above 1939. The chief gains over 1939 were in such industrial States as Pennsylvania, Ohio, West Virginia, and Illinois. In sharp contrast was New York, where a shortage in gas supplies caused curtailment from 23.7 billion cubic feet in 1939 to 6.4 billion in 1940.

California, Pennsylvania, and Louisiana, in order, were the largest users in 1940 of "Other industrial" gas. A decade earlier, in 1930, the first three States in rank were Texas, Pennsylvania, and Louisiana. The greatest expansion in this type of gas market during the 10-year interval has been in California (from 27.0 to 85.4 billion cubic feet) and Illinois (from 6.5 to 52.3 billion). States added to the list of industrial-gas consumers since 1930 as a result of pipe-line construction include Arizona, Florida, Iowa, Minnesota, Virginia, and the District of Columbia.

Mixed gas.—The volume of natural gas used in mixtures with manufactured gas increased 12 percent in 1940 over 1939 to 65,102 million cubic feet, the largest total ever reported. Domestic and commercial consumption increased 10 and 11 percent, respectively, and industrial consumption reversed a 3-year decline by gaining 22 percent to reach 9,822 million cubic feet. The largest gains in industrial use were in Nebraska and Illinois.

The number of domestic and commercial meters in use increased 3 percent; sharp gains in Michigan, Nebraska, and Minnesota more than offset large losses in Missouri, New York, Ohio, Pennsylvania, and Virginia.

Consumption of natural gas used with manufactured gas in the United States in 1940, by States

State	Domestic		Commercial		Industrial (M cubic feet)	Total	
	Consumers	M cubic feet	Consumers	M cubic feet		M cubic feet	Value at points of consumption
District of Columbia	158,960	3,814,000	7,450	359,000	513,000	4,686,000	$3,262,000
Illinois	1,110,010	16,030,000	57,440	4,565,000	5,450,000	26,045,000	25,710,000
Indiana	29,130	440,000	1,440	136,000	43,000	619,000	617,000
Iowa	54,070	1,574,000	3,830	282,000	112,000	1,968,000	2,341,000
Kentucky	75,820	2,893,000	7,290	805,000	899,000	4,597,000	2,535,000
Maryland	21,240	573,000	380	16,000	18,000	607,000	506,000
Michigan	132,540	3,569,000	5,420	372,000	212,000	4,153,000	3,967,000
Minnesota	231,980	3,419,000	12,050	480,000	294,000	4,193,000	4,079,000
Missouri	55,470	1,173,000	390	59,000	141,000	1,373,000	834,000
Nebraska	274,410	8,396,000	22,140	1,547,000	1,418,000	11,361,000	8,803,000
New York	157,730	1,908,000	15,740	644,000	497,000	3,049,000	1,811,000
Ohio	54,570	1,599,000	2,770	315,000	212,000	2,126,000	1,399,000
Pennsylvania	21,230	258,000	560	18,000	13,000	289,000	301,000
Virginia	600	24,000	250	12,000		36,000	37,000
Total: 1940	2,377,760	45,670,000	137,150	9,610,000	9,822,000	65,102,000	56,202,000
1939	2,297,010	41,395,000	132,990	8,679,000	8,039,000	58,113,000	53,952,000

The average value of the natural gas used with manufactured gas declined in 1940 to 86.3 cents per thousand cubic feet from 92.8 cents in 1939, influenced by the substantial gain in industrial consumption.

NEW MARKETS

Available reports indicate that natural-gas service was extended to over 50 communities in 12 States in 1941, affecting a population of about 300,000, of which more than half were in Illinois. A number of large military establishments and war industries were supplied with natural gas, particularly in the Southwest and in California, where this fuel is plentiful.

Larger municipalities reported as changing from manufactured gas to natural in 1941 included: Eureka (Calif.); Alton, Centralia, Mount Vernon, Belleville, and Granite City (Ill.); New Albany (Ind.); and Monroe (Mich.).

Rapid expansion of facilities for producing aluminum, magnesium, and other strategic materials will create new demands for natural gas.

INTERSTATE SHIPMENTS

The normal upward trend of interstate movement of natural gas, which was resumed in 1939, continued to a new peak of 738.8 billion cubic feet in 1940, a 7-percent gain over 1939. The vigorous growth in interstate shipment of gas began in 1928 when the pioneer construction of long-distance gas-transmission facilities was completed. Since 1927 the total increase has been 280 percent, as declines occurred only in the 1931–32 and 1938 periods of depressed business conditions.

Although moderate expansion of exports from gas-producing States has been the rule, Texas and Louisiana have been the principal sources of new gas for markets in other States. Their importance is indicated by the fact that 71 percent of the total increase in interstate movement in the 13-year period came from these two States.

In 1940, new peaks in gas exports were reported from Texas, Louisiana, Kansas, New Mexico, and Montana. The volume from West Virginia was the greatest in any year since 1920. Sharp declines in exports from Mississippi and New York occurred in 1940 because available gas reserves were being rapidly depleted. Demands for gas in Mississippi were met by increasing receipts from Louisiana. In New York many industrial consumers were compelled to change to other fuels because their normal demands could not be met from Pennsylvania sources, which also suffered from sharply reduced local supplies. Thus, shipments from Pennsylvania to New York were cut just when the need for them became great. The needs of Pennsylvania and Ohio consumers were met by substantially increasing receipts of gas from West Virginia, where important additions to available capacity have been made in recent years.

Interstate transportation of natural gas in 1940 [1]

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Colorado	Wyoming	Utah	2,065,000
		Wyoming	126,000
			2,191,000
Illinois		Indiana	280,000
	Indiana	Kentucky	549,000
			829,000
Indiana		Illinois	7,000
		Kentucky	376,000
			383,000
Kansas		Colorado	513,000
	Missouri	Illinois	2,855,000
	do Illinois	Indiana	4,341,000
	Nebraska	Iowa	6,305,000
	do South Dakota	do	12,000
	Missouri Illinois Indiana	Michigan	6,529,000
	Nebraska Iowa	Minnesota	7,415,000
		Missouri	8,971,000
		Nebraska	8,785,000
	Nebraska Iowa	do	5,000
	Missouri Illinois Indiana	Ohio	39,000
		Oklahoma	627,000
	Nebraska	South Dakota	983,000
			47,380,000
Kentucky	West Virginia Virginia Maryland	District of Columbia	4,686,000
		Indiana	96,000
	West Virginia Virginia	Maryland	4,219,000
	West Virginia Virginia Maryland District of Columbia	do	611,000
		Ohio	3,424,000
	West Virginia	do	4,000,000
	do	Pennsylvania	12,913,000
	do	Virginia	623,000
	do Virginia Maryland District of Columbia	do	290,000
		West Virginia	10,959,000
			41,821,000
Louisiana	Mississippi	Alabama	22,729,000
		Arkansas	24,360,000
	Mississippi Alabama	Florida	1,103,000
	Mississippi Alabama	Georgia	20,551,000
	Arkansas Missouri	Illinois	17,917,000
		Mississippi	11,157,000
	Arkansas	do	2,394,000
	do	Missouri	9,926,000
	do Missouri Illinois	do	6,293,000
	Arkansas Mississippi	Tennessee	16,780,000
		Texas	41,156,000
			174,366,000

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1940—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Mississippi		Alabama	732,000
	Alabama	Florida	378,000
		Louisiana	1,149,000
			2,259,000
Missouri		Illinois	18,000
	Illinois	Indiana	28,000
	do. Indiana	Michigan	43,000
			89,000
Montana		North Dakota	1,725,000
	North Dakota	South Dakota	3,802,000
			5,527,000
New Mexico	Texas New Mexico	Arizona	18,002,000
		Colorado	164,000
	Texas New Mexico Arizona	Mexico	685,000
		Texas	6,521,000
			25,372,000
New York		Canada	54,000
		Pennsylvania	2,319,000
			2,373,000
Ohio		Indiana	7,000
		West Virginia	101,000
			108,000
Oklahoma		Arkansas	980,000
	Kansas Missouri	Illinois	66,000
	Kansas Missouri Illinois	Indiana	102,000
	Kansas Nebraska	Iowa	1,610,000
	Kansas Nebraska South Dakota	do.	3,000
		Kansas	21,004,000
	Kansas Missouri Illinois Indiana	Michigan	153,000
	Kansas Nebraska Iowa	Minnesota	1,889,000
		Missouri	9,024,000
	Kansas	Nebraska	1,687,000
	do. Nebraska Iowa	do.	1,000
	Kansas Missouri Illinois Indiana	Ohio	1,000
	Kansas Nebraska	South Dakota	251,000
		Texas	2,529,000
			39,300,000
Pennsylvania	New York	Canada	36,000
		New York	17,436,000
		Ohio	63,000
	West Virginia	do.	425,000
		West Virginia	3,217,000
			21,177,000

Interstate transportation of natural gas in 1940—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Texas	New Mexico	Colorado	21,020,000
	Oklahoma Kansas Missouri	Illinois	5,867,000
	Oklahoma Kansas Nebraska Iowa	do	53,828,000
	Oklahoma Kansas Missouri Illinois	Indiana	8,924,000
	Oklahoma Kansas Nebraska Iowa Illinois	do	14,682,000
	Oklahoma Kansas Nebraska	Iowa	15,512,000
	Oklahoma Kansas Nebraska South Dakota	do	18,000
	Oklahoma	Kansas	33,145,000
		Louisiana	15,115,000
		Mexico	4,788,000
	Oklahoma Kansas Missouri Illinois Indiana	Michigan	13,417,000
	Oklahoma Kansas Nebraska Iowa	Minnesota	10,600,000
	Oklahoma Kansas	Missouri	18,706,000
	Oklahoma Kansas	Nebraska	8,346,000
	Oklahoma Kansas Nebraska Iowa	do	7,000
		New Mexico	1,580,000
	Oklahoma Kansas Missouri Illinois Indiana	Ohio	81,000
		Oklahoma	11,853,000
	Oklahoma Kansas Nebraska	South Dakota	1,409,000
	New Mexico Colorado	Wyoming	552,000
			239,450,000
Utah		do	68,000
Virginia		Tennessee	30,000
West Virginia		Kentucky	6,721,000
		Maryland	1,025,000
		Ohio	77,292,000
	Kentucky	do	4,000,000
		Pennsylvania	36,395,000
	Maryland	do	55,000
			125,488,000
Wyoming		Colorado	72,000
		Montana	1,624,000
		Nebraska	1,256,000
		Utah	7,681,000
			10,633,000
			738,844,000

PIPE-LINE DEVELOPMENTS

Construction of natural-gas pipe lines continued at a high rate in 1941 for the second successive year, and 2,165 miles were completed. In addition, 460 miles were under construction at the end of 1941 and scheduled for early completion.

As in 1940, about one-third of the total new mileage was in loops added to existing major lines to increase their carrying capacity as market needs expand. In several instances, the 1941 expansion was a continuation of programs projected over a period of several years with the purpose of duplicating original trunk lines for their entire length.

The larger looping projects included 403 miles of 26-inch on the Texas Panhandle to Chicago line, of which about 350 miles were completed in 1941; 203 miles of 10- to 16-inch pipe on the line from southeast New Mexico fields to El Paso, Tex., and markets in Arizona; 55 miles of 18-inch added to the line from Monroe, La., to Memphis, Tenn.; 26 miles of 24-inch loop added to the Texas Panhandle to Minneapolis (Minn.) line; and 64 miles of 8- and 18-inch installed in the system that brings gas from Wyoming and vicinity to Salt Lake City, Utah.

About three-quarters of the new mileage was in the Southwestern States, with Texas most active. In all, 19 projects were reported in Texas, of which the following were the largest: 190 miles of 14- and 16-inch line from the West Ranch field to Beaumont to provide fuel for refineries; 27 miles of 12-inch from the Sewell field to Brad, Palo Pinto County; 19 miles of 12-inch to bring gas from the Grapeland cycling plant to the main line at Long Lake; 26 miles of 8-inch from West Beaumont to Port Arthur; 22 miles of 8-inch to bring gas from the Angleton field to Freeport; and 22 miles of 6- and 8-inch from Aldine to Houston.

Ten projects were reported for Louisiana, of which two were outstanding: The laying of 135 miles of 20-inch to bring gas from the Logansport field to a connection at Monroe with the main line serving Alabama and Georgia markets; and construction of a 216-mile line of 12-, 14-, and 16-inch originating in the Lirette field, La., and extending eastward to Mobile, Ala. A 25.6-mile section of this line is submerged under Lake Pontchartrain.

Oklahoma also had 10 new lines, most of which were small. The largest consisted of 55 miles of 16-inch pipe from the Cement field to connect with a major system near Oklahoma City. An 8-inch line was laid from Elgin to bring gas to Fort Sill, and 7.5 miles of 16-inch were laid from the Cement-field line to an airport near Oklahoma City.

Of five Kansas projects, one was of considerable size, in addition to the loops; it consisted of 146 miles of 8-inch running from Scott City, Kans., to Cambridge, Nebr.

No major new lines were reported in the Rocky Mountain States. The two largest were in Wyoming and consisted of 21 miles of 8-inch from the Garland field to the Elk Basin-Billings main line and 17 miles of 8-inch providing an outlet from the Powder Wash gas field to the Salt Lake City trunk line, connecting at Hiawatha.

Eight small lines were laid in the Illinois-Indiana area; the largest was 45 miles of 8-inch under construction from a trunk line at Peoria to Galesburg, Ill.

Thirty miles of 12-inch were laid in Ohio in Hocking, Fairfield, and Richland Counties, apparently terminating at Lucas.

Michigan reported six projects, among which were a 45-mile, 12-inch line under construction from Saginaw to Flint and a 39-mile, 12-inch line from Wise Station near Midland to McBain.

In West Virginia continued development of new supplies of gas near Charleston stimulated construction. Nine new lines were reported, the two largest being scheduled for completion early in 1942; these were 46 miles of 12-inch from Ripley to Waverly, Wood County, and 38 miles of 14- and 18-inch from New Era, W. Va., to Gravel Bank, Ohio. In Jackson County 38 miles of 6-, 8-, and 10-inch field lines were laid, and a 12-inch line was run from Goldtown to Ripley, a distance of 16 miles.

California had little activity, with only four small projects; the largest was about 19 miles of 12-inch connecting the Rio Vista field with the trunk line serving San Francisco at Woodbridge.

NATURAL GASOLINE

AND LIQUEFIED PETROLEUM GASES [1]

By F. S. Lott and A. T. Coumbe [2]

NATURAL GASOLINE

SUMMARY

To the natural-gasoline industry, 1941 was the most profitable of any recent year. The volume of production increased sharply (15 percent) to about 2,697 million gallons and set a new record for the second successive year. The total demand for natural gasoline outstripped production, gained 21 percent to 2,757 million gallons, and caused a draft of 60 million gallons on stocks.

Spot Mid-Continent prices, which began to recover late in 1940 from extremely low levels, averaged 2.4 cents per gallon in January 1941 and advanced steadily throughout the year to an average of 5.1 cents in December. Estimated yearly average values realized by producers are approximately 1 cent per gallon above spot prices. Such average values of 2.9 cents per gallon for 1940 and 4.7 cents for 1941 indicate that the gross value of natural gasoline distributed was 95 percent higher in 1941 than in 1940—a surprising improvement. Early in 1942, however, prices broke sharply as marketing facilities were restricted by transportation difficulties attributable to the war.

The proportion of natural gasoline blended in refinery gasoline returned in 1941 to a more nearly normal level (7.1 percent) from the 6.6 percent that had prevailed in 1939 and 1940.

Figures showing total exports for 1941 cannot be published; they are therefore combined with "losses" in this report.

The average yield of gasoline from natural gas probably continued the declining trend of recent years. Average vapor pressure, however, recovered from the low point of 1940 owing to increased requirements for the lighter products by refiners. This change may have been influenced in some degree by sharply higher demand for the ingredients from which aviation gasoline could be manufactured.

[1] Data for 1941 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by E. M. Seeley, Petroleum Economics Division, Bureau of Mines.

Salient statistics of the natural-gasoline industry in the United States, 1937–41, in thousands of gallons

	1937	1938	1939	1940	1941 [1]	Percent of change from 1940
Production:						
Appalachian	72, 056	68, 541	71, 507	82, 232	92, 012	+11.9
Illinois, Kentucky, and Michigan	12, 319	13, 057	14, 768	34, 957	68, 811	+96.8
Oklahoma City	166, 188	141, 516	104, 268	81, 560	70, 384	−13.7
Seminole	121, 839	122, 144	127, 214	117, 944	110, 371	−6.4
Texas Panhandle	230, 405	249, 968	260, 488	258, 465	290, 861	+12.5
East Texas	185, 313	188, 117	190, 267	165, 182	177, 035	+7.2
Rocky Mountain	74, 868	82, 397	88, 719	92, 798	100, 817	+8.6
Kettleman Hills	182, 894	186, 780	156, 514	127, 259	115, 568	−9.2
Long Beach	84, 297	92, 675	86, 213	89, 631	88, 290	−1.5
All other districts	935, 255	1, 011, 379	1, 069, 342	1, 289, 372	1, 582, 419	+22.7
Total production	2, 065, 434	2, 156, 574	2, 169, 300	2, 339, 400	2, 696, 568	+15.3
Stocks:						
Total at plants, terminals, and refineries, Jan. 1	170, 310	199, 836	202, 860	185, 682	239, 568	
Total at plants, terminals, and refineries, Dec. 31	199, 836	202, 860	185, 682	239, 568	179, 550	−25.1
Net change	+29, 526	+3, 024	−17, 178	53, 886	−60, 018	
Total supply [2]	2, 035, 908	2, 153, 550	2, 186, 478	2, 285, 514	2, 756, 586	+20.6
Distribution:						
Used at refineries [3]	1, 654, 002	1, 678, 362	1, 663, 452	1, 660, 974	2, 008, 650	+20.9
Refinery-owned bulk plants	27, 888	39, 270	49, 938	64, 596	79, 002	+22.3
Exports	148, 428	256, 914	172, 662	71, 526	(4)	(4)
Jobbers and retailers	143, 640	137, 970	121, 128	218, 694	323, 316	+47.8
Losses	61, 950	11, 034	179, 298	269, 724	345, 618	(4)
Total distribution	2, 035, 908	2, 153, 550	2, 186, 478	2, 285, 514	2, 756, 586	+20.6

[1] Subject to revision.
[2] Production plus or minus changes in stocks.
[3] Including quantities run through crude-oil pipe lines.
[4] Publication of exports suspended; figures combined with losses.

PRICES AND MARKET CONDITIONS

After an all-time low of 1.5 cents per gallon in June 1940, the price of natural gasoline, as indicated by the market for the 26–70 grade in the Mid-Continent district, hardened gradually, then moved upward vigorously. The pressure of demand exceeded the peak production of 1941 and drove prices progressively higher from an

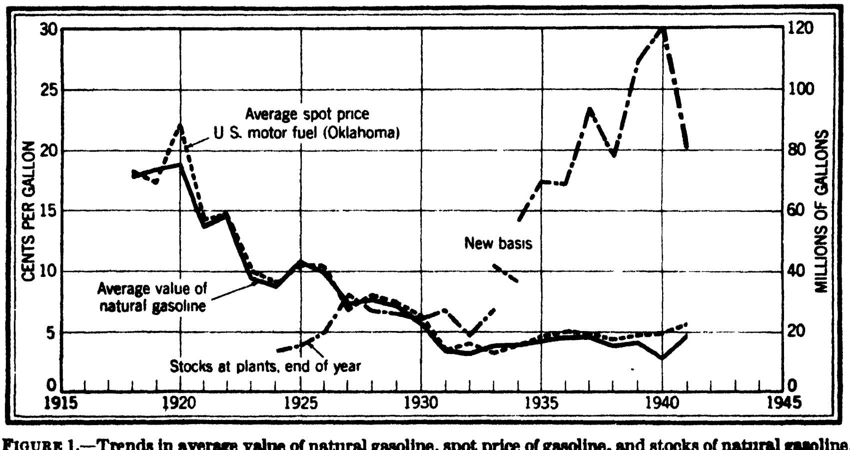

FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–41

average of 2.38 cents in January 1941 to the year's high of 5.13 cents in November and December; this proved to be the top of the rise, as a drastic price decline followed early in 1942.

In figure 1 the curve showing average values of natural gasoline is based upon estimates of the Bureau of Mines. The curve of average spot prices of United States motor fuel (Oklahoma) currently refers to 72–74 octane, after several adjustments from lower octane specifications. Past changes are described in detail on pages 985–987 of Minerals Yearbook, Review of 1940.

Prices to blenders of Mid-Continent natural gasoline, grade 26–70, with dates of price changes in 1941 and monthly and yearly average in cents per gallon

[National Petroleum New]

Date	Cents
Jan. 1	2.38
Average	2.38
Feb. 28	2.38-2.50
Average	2.38
Mar. 1	2.50
4	2.63
25	2.75
28	2.75-2.88
29	2.88
Average	2.66
Apr. 21	3.00
22	3.13
24	3.13-3.25
25	3.13
26	3.13-3.25
28	3.13
29	3.25
Average	2.97
May 16	3.25-3.38
19	3.25
20	3.25-3.38
21	3.25-3.50
22	3.38
23	3.38-3.50
26	3.38
31	3.38-3.50
Average	3.31
June 3	3.38
5	3.50
6	3.38
12	3.38-3.50
13	3.38
14	3.38-3.50
16	3.38
18	3.38-3.50
19	3.38
20	3.38-3.50
23	3.38
25	3.38-3.50
26	3.38
27	3.38-3.50
28	3.38
Average	3.40
July 2	3.38-3.50
7	3.38
8	3.38-3.50
9	3.38
10	3.38-3.50
12	3.50
14	3.38
15	3.63
17	3.50-3.63
18	3.63
19	3.50-3.75
21	3.63
23	3.63-3.75
26	3.63
29	3.63-3.75
30	3.63
31	3.63-3.75
Average	3.55
Aug. 1	3.63
2	3.63-3.75
12	3.75
13	3.75-4.00
18	3.75
19	3.88
20	3.88-4.00
21	4.00
23	4.13
Average	3.88
Sept. 2	4.25
8	4.38
9	4.50
16	4.63
18	4.63-4.75
19	4.63
22	4.63-4.75
Average	4.53
Oct. 1	4.88
8	5.13
17	5.13-5.25
18	5.13
20	5.13-5.25
21	5.13
Average	5.07
November. Average	5.13
December Average	5.13
Average: 1941	3.70
1940	1.94

PRODUCTION

Trends in total output.—Except for temporary dislocations caused by unusual field developments, the trends of production of natural gasoline and crude oil have been roughly parallel for many years (see fig. 2). In 1941 the gain in natural-gasoline production over 1940 exceeded 15 percent, whereas that in crude-oil production was only 4 percent.

The chief cause of divergent trends in 1941 was rapid expansion of output by cycling plants whose operation is not directly related to rates of crude-oil yield. In Texas (and to a lesser extent in Louisiana) cycling-plant activity was reflected in sharply higher production of natural gasoline.

The rate of natural-gasoline output for the United States increased consistently during 1941 from a daily average of 6.7 million gallons in the first quarter to over 8.2 million gallons in the fourth quarter. Production of crude oil followed a similar, though more gradual, upward course.

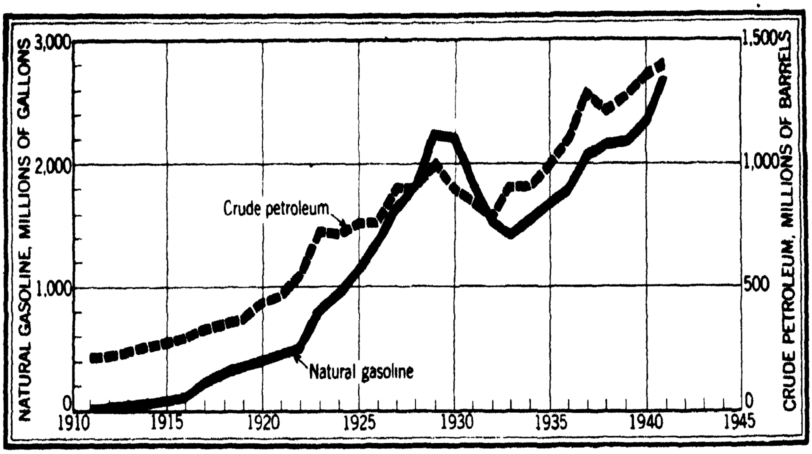

FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911–41.

Natural gasoline produced in the United States, 1937–41, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
1937	11,285	623,894	404	2.567	57,026	7,344	106.415	2,408	2,296	38,253
1938	25,648	660,890	386	2,436	55,988	7,040	95,634	3,581	1,768	49,596
1939	24,634	607,237	390	4,012	62,175	7,785	94,090	2,971	2,161	54,707
1940	32,096	587,476	380	21,499	64,691	9,539	113,741	3,919	2,603	55,713
1941 [1]	35,394	579,969	268	55,077	72,443	10,153	183,139	3,581	2,504	61,633

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming [2]	Total: Thousands of gallons	Total: Value at plant: Thousands of dollars	Total: Value at plant: Average per gallon (cents)
1937	33	7,704	492,290	13,940	615,281	50,379	33,915	2,065,434	97,125	4.7
1938	27	7,382	468,499	10,734	685,920	50,398	30,647	2,156,574	87,266	4.0
1939	34	7,445	436.123	11,756	770,047	52,272	31,461	2,169,300	90,050	4.2
1940	17	8,062	399,369	15,371	932,040	58,782	34,102	2,339,400	68,261	2.9
1941 [1]	17	8,037	381,111	15,610	1,182,872	68,348	36,412	2,696,568	126,700	4.7

[1] Subject to revision.
[2] Includes Utah in each year

Monthly production of natural gasoline in the United States, 1940–41, by fields, in millions of gallons

Field	January	February	March	April	May	June	July	August	September	October	November	December	Total
1940													
Appalachian	9.2	8.3	8.1	6.9	5.8	4.8	4.7	4.7	5.5	7.0	8.3	8.9	82.2
Illinois, Kentucky, and Michigan	2.2	2.0	2.1	2.2	2.1	2.6	2.8	2.7	3.2	3.9	4.3	4.9	35.0
Oklahoma:													
Oklahoma City	7.5	6.9	6.7	6.8	6.9	6.3	6.4	6.6	6.9	7.8	6.7	6.1	81.6
Osage County	3.7	4.1	4.4	4.2	4.9	4.5	4.6	4.6	4.4	4.8	4.6	4.4	53.2
Seminole	8.3	9.2	10.3	10.2	10.6	10.1	10.4	10.3	10.1	10.2	9.1	9.1	117.9
Rest of State	11.9	11.5	12.5	12.3	12.7	12.1	12.2	12.2	11.9	12.8	12.3	12.3	146.7
Total Oklahoma	31.4	31.7	33.9	33.5	35.1	33.0	33.6	33.7	33.3	35.6	32.7	31.9	399.4
Kansas	6.1	5.7	5.4	5.3	5.2	4.9	4.6	4.8	4.8	5.7	5.9	6.3	64.7
Texas:													
Gulf Coast	9.1	10.3	14.0	14.2	14.8	14.1	18.0	18.6	19.9	21.7	22.1	22.4	199.2
East Texas	12.7	12.5	14.1	14.2	14.4	14.0	15.6	14.9	14.0	14.2	12.6	12.0	165.2
North Texas	3.6	3.7	4.0	4.0	3.9	3.7	3.7	3.7	3.6	3.9	3.6	3.5	44.9
Panhandle	21.4	20.6	21.4	20.6	22.0	19.8	22.1	20.1	22.5	22.4	21.8	23.7	258.4
West Central	5.2	5.2	5.4	5.1	5.1	4.9	5.1	5.0	5.2	5.4	5.2	5.1	61.9
West Texas	5.0	5.1	6.7	7.1	7.3	7.3	7.3	7.5	7.6	7.5	5.8	5.8	80.0
Rest of State	7.6	8.5	7.9	8.6	8.8	9.1	9.9	10.3	10.7	13.1	13.3	14.6	122.4
Total Texas	64.6	65.9	73.5	73.8	76.3	72.9	81.7	80.1	83.5	88.2	84.4	87.1	932.0
Louisiana	9.6	9.2	8.3	8.5	9.5	9.1	9.4	10.1	9.7	9.7	10.2	10.4	113.7
Arkansas	1.4	1.6	2.8	2.8	3.0	2.9	3.1	3.0	2.9	3.1	2.7	2.8	32.1
Rocky Mountain	6.8	6.5	7.1	6.9	8.4	8.1	8.5	8.4	7.8	8.7	7.8	7.8	92.8
California:													
Huntington Beach	2.6	2.5	2.8	2.7	2.8	2.6	2.7	2.7	2.5	2.6	2.5	2.6	31.6
Kettleman Hills	10.6	9.9	10.5	10.1	10.7	10.4	10.6	10.9	10.5	12.0	10.6	10.5	127.3
Long Beach	7.2	6.9	7.5	7.3	7.7	7.4	7.8	7.9	7.6	7.6	7.3	7.5	89.7
Santa Fe Springs	4.8	4.5	4.8	4.5	4.7	4.8	4.8	4.9	4.7	4.9	4.6	4.8	56.8
Ventura Avenue	5.8	5.5	5.5	4.9	5.1	5.1	5.4	5.4	5.1	5.5	5.4	5.4	64.1
Rest of State	18.6	16.9	17.8	17.6	17.9	17.8	18.6	18.9	18.1	19.0	18.2	18.6	218.0
Total California	49.6	46.2	48.9	47.1	48.9	48.1	49.9	50.7	48.5	51.6	48.6	49.4	587.5
Total United States	180.9	177.1	190.1	187.0	194.3	186.4	198.3	198.2	199.2	213.5	204.9	209.5	2,339.4
Daily average	5.8	6.1	6.1	6.2	6.3	6.2	6.4	6.4	6.6	6.9	6.8	6.8	6.4
1941 [1]													
Appalachian	9.3	8.5	9.1	7.2	6.9	6.0	5.6	5.9	6.3	7.9	9.3	10.0	92.0
Illinois, Kentucky, and Michigan	4.8	4.4	5.1	4.9	5.3	5.3	5.5	5.8	5.7	6.9	7.4	7.7	68.8
Oklahoma:													
Oklahoma City	6.5	5.7	6.2	5.9	5.3	5.3	5.5	6.1	5.6	6.3	6.3	5.7	70.4
Osage County	4.0	4.1	4.5	4.6	4.7	4.8	5.0	5.1	5.6	5.0	5.2	5.0	57.6
Seminole	8.8	7.8	9.0	9.2	9.7	9.5	9.5	9.6	9.7	9.9	9.0	8.7	110.4
Rest of State	12.2	10.9	11.9	11.4	11.7	11.3	11.4	11.8	11.7	12.7	12.6	13.1	142.7
Total Oklahoma	31.5	28.5	31.6	31.1	31.4	30.9	31.4	32.6	32.6	33.9	33.1	32.5	381.1
Kansas	6.8	6.7	6.3	5.7	5.5	5.3	5.2	5.3	5.6	6.4	6.8	6.9	72.5
Texas:													
Gulf Coast	20.1	19.4	20.6	20.9	22.4	23.7	26.2	27.2	27.7	29.3	31.8	33.1	302.4
East Texas	12.5	11.6	13.2	14.3	16.0	15.9	15.9	16.6	15.6	16.1	14.6	14.7	177.0
North Texas	2.2	2.0	2.1	2.2	2.4	2.3	2.4	2.2	2.3	2.4	2.3	2.3	27.1
Panhandle	22.4	23.2	22.9	24.2	24.5	23.3	23.5	24.3	24.8	26.3	25.9	25.6	290.9
West Central	5.3	4.8	5.1	4.9	5.1	4.6	4.7	4.9	4.8	5.1	4.9	4.9	59.1
West Texas	5.8	5.5	6.6	7.3	8.1	8.0	8.1	8.0	8.1	7.9	7.4	7.1	87.9
Rest of State	15.5	13.9	15.5	18.9	19.8	19.6	20.0	22.1	22.2	22.8	23.2	25.0	238.5
Total Texas	83.8	80.4	86.0	92.7	98.3	97.4	100.8	105.3	105.5	109.9	110.1	112.7	1,182.9
Louisiana	9.3	9.1	10.0	9.9	9.3	9.6	10.5	20.3	22.1	23.0	25.1	24.9	183.1
Arkansas	2.9	2.5	2.9	2.8	3.0	2.9	3.0	2.9	2.9	3.3	3.2	3.1	35.4
Rocky Mountain	7.9	7.1	7.9	8.1	8.7	8.7	8.9	8.9	8.5	8.6	8.8	8.7	100.8
California:													
Huntington Beach	2.6	2.3	2.6	2.4	2.7	2.7	2.7	2.9	2.8	2.8	2.5	2.7	31.7
Kettleman Hills	10.5	9.4	9.2	9.4	9.6	9.1	9.7	9.4	9.6	10.2	9.6	9.9	115.6
Long Beach	7.4	6.8	7.5	7.2	7.8	7.5	7.6	7.5	7.2	7.4	7.2	7.2	88.3
Santa Fe Springs	4.7	4.3	4.7	4.6	4.9	4.7	4.7	4.8	4.6	4.6	4.4	4.5	55.5
Ventura Avenue	5.0	4.5	4.9	4.6	4.8	4.5	4.7	4.9	4.6	5.0	5.3	5.3	58.1
Rest of State	18.6	17.2	18.7	18.6	19.4	19.4	20.3	20.3	19.9	20.1	19.0	19.3	230.8
Total California	48.8	44.5	47.6	46.8	49.2	47.9	49.7	49.8	48.7	50.1	48.0	48.9	580.0
Total United States	205.1	191.7	206.5	209.2	217.6	214.0	220.6	236.8	237.9	250.0	251.8	255.4	2,696.6
Daily average	6.6	6.8	6.7	7.0	7.0	7.1	7.1	7.6	7.9	8.1	8.4	8.2	7.4

[1] Subject to revision

California.—Natural-gasoline production fell 1 percent in 1941 to 580 million gallons and continued the decline that began in 1939, following the peak of gasoline yield from the great Kettleman Hills field. A modest gain in output of natural gasoline from the smaller fields included in the "Rest of State" section during 1941 could not offset the shrinkage in production from Kettleman Hills and Ventura Avenue.

Louisiana.—In 1941 production in Louisiana rose 61 percent to a new peak of 183 million gallons. Most of the increase in output was accredited to a new cycling plant in the Cotton Valley field in northwestern Louisiana, which began operating in July 1941. Its reported capacity exceeds 12 million gallons of liquid products per month, or enough to double the State's recent output of these products.

Oklahoma.—In 1941 natural-gasoline production continued the decline that began in 1938, the total being 381 million gallons compared with 399 million in 1940. Moderate declines occurred in all areas except Osage County, where an increase of 4 million gallons was reported.

Texas.—A 27-percent increase in Texas production to 1,183 million gallons in 1941 dwarfed the previous record output of 1940. Gains were reported in all districts except relatively unimportant North Texas and West Central Texas. The "Rest of State" and Gulf Coast areas, which include most cycling plants, showed conspicuous gains of 95 and 52 percent, respectively, in output over 1940.

As predicted in 1941 (in the preceding chapter of this series), the Gulf Coast area displaced the Panhandle as the leading producing district of Texas, despite a 13-percent increase in Panhandle production during 1941. Texas enlarged its proportion of the total natural-gasoline output of the United States to 44 percent in 1941 from 40 percent in 1940.

Natural gasoline produced and natural gas treated in the United States in 1940, by States [1]

State	Number of operators [2]	Number of plants operating	Natural gasoline produced: Thousands of gallons	Natural gasoline produced: Value at plants: Thousands of dollars	Natural gasoline produced: Value at plants: Average per gallon (cents)	Natural gas treated: Millions of cubic feet	Natural gas treated: Average yield per M cubic feet (gallons)
Arkansas	6	8	32,096	818	2.5	26,584	1.21
California	33	90	587,476	27,901	4.7	375,407	1.56
Colorado	2	2	380	14	3.7	142	2.68
Illinois	23	53	21,499	805	3.7	12,716	1.69
Kansas	10	15	64,691	1,295	2.0	150,963	.43
Kentucky	5	5	9,539	350	3.7	39,662	.24
Louisiana	16	27	113,741	2,552	2.2	145,234	.78
Michigan	1	3	3,919	162	4.1	1,414	2.77
Montana	1	1	2,603	162	6.2	9,528	.27
New Mexico	5	7	55,713	879	1.6	101,213	55
New York	1	1	17	1	5.9	40	43
Ohio	9	12	8,062	333	4.1	38,547	21
Oklahoma	49	120	399,369	8,926	2.2	219,255	1.82
Pennsylvania	55	83	15,371	594	3.9	40,161	38
Texas	93	174	932,040	20,322	2.2	1,123,236	83
Utah			722	28	3.9		
West Virginia	22	76	58,782	1,848	3.1	168,206	.35
Wyoming	5	7	33,380	1,271	3.8	19,092	1.75
Total: 1940	[2] 276	684	2,339,400	68,261	2.9	2,471,400	.95
1939	[2] 260	684	2,169,300	90,050	4.2	2,150,000	1.01

[1] Complete figures for 1941 not yet available.
[2] A producer operating in more than 1 State is counted but once in arriving at total for United States.

Other States.—Except for insignificant declines in Colorado, Michigan, Montana, and Ohio, natural-gasoline production was larger in 1941 than in 1940 in each of the other producing States of this group. The largest gain (34 million gallons) occurred in Illinois, where rapid expansion of gasoline-plant operations continued for the third successive year in the wake of oil development. Material gains were reported also in West Virginia, Kansas, and New Mexico, where pronounced upward trends in natural-gasoline production have been evident for several years.

CONSUMPTION AND MOVEMENTS

Stimulated by conditions arising from the war situation abroad, the demand for natural gasoline in 1941 increased more than 20 percent to nearly 2,760 million gallons contrasted with 2,286 million in 1940. Production did not meet demand, prompting withdrawal of 60 million gallons from storage in 1941 and reversing the conditions of 1940, when 54 million gallons of natural gasoline were added to stocks.

Refinery utilization represented about 73 percent of total demand in 1941, as in 1940; "direct" sales absorbed 12 percent, and their relative importance increased from 10 percent in 1940. Exports and losses are grouped for 1941 to avoid disclosure of data regarding the former. They jointly amounted to 13 percent of total demand in 1941 and 15 percent in 1940.

Refinery utilization.—The proportion of natural gasoline used at refineries in motor fuel during 1941 increased to 7.1 percent after remaining at the comparatively low level of 6.6 percent in 1939 and 1940. A greater proportionate use of "natural" was reported generally in 1941, and the only notable decline was in the Oklahoma-Kansas-Missouri district (from 8.0 to 6.6 percent).

Percentage of natural gasoline in refinery gasoline in the United States, 1937–41, by districts

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky Mountain	California	Total
1937	1.9	1.8	4.3	8.5	13.1	5.3	4.6	6.5	6.1	15.7	7.0
1938	1.6	1.4	4.7	8.8	15.5	4.3	2.2	6.8	5.8	17.6	7.2
1939	2.7	1.4	4.1	7.8	14.3	3.5	2.1	5.0	4.7	18.0	6.6
1940	2.0	1.6	4.5	8.0	16.6	4.4	1.7	3.3	4.5	15.7	6.6
1941 [1]	2.3	1.9	5.3	6.6	17.6	5.6	3.7	6.1	4.4	16.1	7.1

[1] Subject to revision

The wide variation among districts in the ratios of natural gasoline utilized in refinery gasoline (1.9 percent in the Appalachian region in 1941 to 17.6 in Texas Inland) suggests the great flexibility, from a technical standpoint, of this operation. Control of the ratio in a particular area is exercised chiefly by economic factors; geographic location and transportation costs probably dominate.

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"Direct" sales.—The pronounced upward trend in shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants (which began in 1940 and continued through 1941) has been due almost entirely to Texas intrastate deliveries which in 1941 were five times those in 1939 when they comprised 22 percent of all "direct" shipments, as contrasted with 49 percent in 1941. Gains were reported in Louisiana and Arkansas deliveries. Cycling-plant operations play an important part in the Texas situation, for they produce much material that can be used as motor fuel with little or no additional processing.

Distribution of natural gasoline in the United States, 1940–41, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1940													
Production	180,936	177,072	190,134	186,984	194,250	186,396	198,324	198,156	199,206	213,528	204,918	209,496	2,339,400
Decrease in all stocks									27,888	19,698	19,614	16,716	
	180,936	177,072	190,134	186,984	194,250	186,396	198,324	198,156	227,094	233,226	224,532	226,212	2,339,400
Used at refineries [1]	137,970	129,822	127,428	119,826	129,990	110,040	116,256	129,864	157,248	174,552	169,092	158,886	1,660,974
Refinery-owned bulk plants	6,552	4,200	6,132	4,536	4,746	6,342	5,040	4,410	6,594	4,746	4,494	6,804	64,596
Jobbers and retailers	11,214	10,710	15,582	15,078	14,448	14,490	16,968	18,018	22,302	29,190	25,704	24,990	218,694
Exports [2]	7,728	3,024	8,904	2,856	7,224	11,256	5,292	6,090	6,804	2,940	2,772	6,636	71,526
Increase in all stocks	2,310	11,802	26,712	30,198	16,884	20,412	24,528	4,956					53,886
Losses	15,162	17,514	5,376	14,490	20,958	23,856	30,240	34,818	34,146	21,798	22,470	28,896	269,724
	180,936	177,072	190,134	186,984	194,250	186,396	198,324	198,156	227,094	233,226	224,532	226,212	2,339,400
1941 [3]													
Production	205,128	191,730	206,472	209,160	217,602	213,990	220,584	236,838	237,888	249,984	251,748	255,444	2,696,568
Decrease in all stocks	8,988	7,518						8,652	30,996	21,126	13,146	11,844	60,018
	214,116	199,248	206,472	209,160	217,602	213,990	220,584	245,490	268,884	271,110	264,894	267,288	2,756,586
Used at refineries [1]	160,776	139,104	158,508	146,916	142,758	147,756	152,376	173,460	199,542	209,874	189,756	187,824	2,008,650
Refinery-owned bulk plants	7,896	8,316	8,694	7,980	5,964	5,460	5,922	4,494	4,326	5,292	8,358	6,300	79,002
Jobbers and retailers	28,812	22,932	24,234	19,824	22,050	23,394	22,008	28,308	26,922	28,980	32,340	43,512	323,316
Increase in all stocks			840	7,266	14,784	15,918	3,444						
Losses and exports	16,632	28,896	14,196	27,174	32,046	21,462	36,834	39,228	38,094	26,964	34,440	29,652	345,618
	214,116	199,248	206,472	209,160	217,602	213,990	220,584	245,490	268,884	271,110	264,894	267,288	2,756,586

[1] Includes quantities run through pipe lines

[2] Figures compiled by the Department of Commerce.

[3] Subject to revision.

Natural gasoline utilized at refineries in the United States, 1940–41, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1940													
East Coast	6,762	4,074	5,208	6,384	5,922	5,670	4,788	3,948	6,552	8,484	8,442	8,988	75,222
Appalachian	1,428	1,512	1,596	1,176	840	1,008	1,344	1,050	1,470	1,512	1,638	1,554	16,128
Indiana, Illinois, Kentucky, etc	17,220	18,858	17,892	15,876	17,010	16,212	17,472	19,614	22,260	26,292	26,628	23,436	238,770
Oklahoma, Kansas, and Missouri	21,000	17,472	17,094	16,506	16,296	14,868	15,414	18,060	20,748	21,840	20,538	20,160	219,996
Texas:													
Gulf Coast	18,732	17,094	17,934	16,254	27,972	17,220	17,136	22,092	29,190	25,536	34,020	23,520	266,700
Inland	25,116	24,780	23,394	21,966	21,378	17,136	18,228	21,126	27,048	29,484	23,646	26,040	279,342
Total Texas	43,848	41,874	41,328	38,220	49,350	34,356	35,364	43,218	56,238	55,020	57,666	49,560	546,042
Louisiana-Arkansas:													
Louisiana Gulf Coast	714	462	756	924	630	588	672	630	1,344	2,478	1,008	1,470	11,676
Arkansas and Louisiana Inland	1,512	1,470	1,470	882	1,134	966	756	966	1,008	1,428	1,470	2,100	15,162
Total Louisiana-Arkansas	2,226	1,932	2,226	1,806	1,764	1,554	1,428	1,596	2,352	3,906	2,478	3,570	26,838
Rocky Mountain	3,444	3,150	3,318	1,974	924	1,512	1,554	1,638	2,226	3,192	4,074	3,738	30,744
California	42,042	40,950	38,766	37,884	37,884	34,860	38,892	40,740	45,402	54,306	47,628	47,880	507,234
Total United States	137,970	129,822	127,428	119,826	129,990	110,040	116,256	129,864	157,248	174,552	169,092	158,886	1,660,974
1941 [1]													
East Coast	8,778	7,518	6,258	5,376	5,418	4,368	5,670	6,090	7,770	7,770	8,568	9,744	83,328
Appalachian	1,428	1,722	1,764	2,142	1,554	1,218	1,596	1,134	1,974	1,848	1,806	2,100	20,286
Indiana, Illinois, Kentucky, etc	24,780	22,680	22,890	24,864	23,184	23,226	25,158	26,208	28,224	30,618	28,350	29,400	309,582
Oklahoma, Kansas, and Missouri	17,976	14,784	15,792	14,070	13,734	12,936	14,154	15,960	20,118	18,606	20,034	19,236	197,400
Texas:													
Gulf Coast	21,924	19,152	25,662	27,174	25,074	29,610	28,812	35,868	46,536	43,932	42,000	46,914	392,658
Inland	32,004	24,990	26,964	23,058	24,234	24,990	24,864	28,056	28,728	32,550	27,090	29,316	326,844
Total Texas	53,928	44,142	52,626	50,232	49,308	54,600	53,676	63,924	75,264	76,482	69,090	76,230	719,502
Louisiana-Arkansas:													
Louisiana Gulf Coast	1,050	798	1,428	1,008	1,344	924	924	3,906	4,284	5,376	5,502	6,174	32,718
Arkansas and Louisiana Inland	2,226	1,890	1,470	1,386	1,134	1,260	1,386	4,578	4,662	5,880	3,696	4,158	33,726
Total Louisiana-Arkansas	3,276	2,688	2,898	2,394	2,478	2,184	2,310	8,484	8,946	11,256	9,198	10,332	66,444
Rocky Mountain	3,780	3,108	2,646	2,184	2,352	2,100	1,638	2,352	2,310	3,150	3,822	3,696	33,138
California	46,830	42,462	53,634	45,654	44,730	47,124	48,174	49,308	54,936	60,144	48,888	37,086	578,970
Total United States	160,776	139,104	158,508	146,916	142,758	147,756	152,376	173,460	199,542	209,874	189,756	187,824	2,008,650

[1] Subject to revision

Shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants in the United States in 1941, by States, in thousands of gallons [1]

State from which natural gasoline was transported	State to which natural gasoline was transported							Total
	Texas	Minnesota	Arkansas	Illinois	Louisiana	Iowa	Other States	
Texas	196,378	23,100	26	10,772	567	13,812	27,201	271,856
Oklahoma	1,043	7,776	180	6,185	40	2,391	15,490	33,105
Louisiana	4,131	716	600	837	17,735	1,583	2,670	28,272
West Virginia							26,164	26,164
Arkansas	16		19,541		347		355	20,259
Ohio							6,854	6,854
Other	122	1,990		1,542		578	11,576	15,808
	201,690	33,582	20,347	19,336	18,689	18,364	90,310	402,318

[1] Subject to revision.

Water-borne shipments.—All information regarding ocean movement of natural gasoline in 1941 must be withheld as a war measure to avoid giving possible aid to the enemy.

STOCKS

Stocks of natural gasoline in the United States declined from 240 million gallons at the end of 1940 to 180 million gallons on December 31, 1941, more than canceling the 54 million gallons added to stocks during 1940. Total stocks continued to accumulate in 1941 until a peak of 265 million gallons was reached in July; thereafter withdrawals were rapid until the end of the year.

About half of the net reduction in stocks took place at California refineries, where a downward trend persisted throughout the year. The other half was withdrawn from stocks at Texas plants and terminals during the latter 6 months of 1941. A 10-million-gallon increase in the relatively small stocks of natural gasoline at refineries outside of California was almost offset by an 8-million-gallon decline in plant and terminal stocks elsewhere than in Texas.

Stocks of natural gasoline in the United States, 1940–41, by months, in thousands of gallons

Date	At refineries				At plants and terminals				Total	
	California		Other States		Texas		Other States			
	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]	1940	1941 [1]
Jan. 1	59,136	99,624	17,430	19,614	78,492	86,045	30,624	34,285	185,682	239,568
Jan. 31	64,638	96,894	17,262	20,622	78,954	77,589	27,138	35,475	187,992	230,580
Feb. 28	67,494	94,962	19,110	17,346	82,268	74,000	30,922	36,754	199,794	223,062
Mar. 31	74,172	87,024	20,874	19,194	93,347	78,631	38,113	39,053	226,506	223,902
Apr. 30	79,758	83,580	32,928	18,018	97,587	91,736	46,431	37,834	256,704	231,168
May 31	87,864	82,824	33,054	17,472	97,355	102,667	55,315	42,989	273,588	245,952
June 30	95,928	82,530	37,758	20,454	104,167	111,210	56,147	47,676	294,000	261,870
July 31	106,974	83,412	43,386	28,224	116,340	106,232	51,828	47,446	318,528	265,314
Aug. 31	111,930	80,052	40,614	27,384	122,601	100,222	48,339	49,004	323,484	256,662
Sept. 30	110,670	70,182	33,810	25,116	110,924	84,899	40,192	45,469	295,596	225,666
Oct. 31	104,790	61,068	32,298	25,620	103,273	78,780	35,537	39,072	275,898	204,540
Nov. 30	102,522	58,506	24,276	28,476	95,125	67,796	34,361	36,616	256,284	191,394
Dec. 31	99,624	69,636	19,614	29,358	86,045	53,904	34,285	26,652	239,568	179,550

[1] Subject to revision.

Natural gasoline produced in the United States in 1940, by States and by methods of manufacture [1]

State	Number of plants operating			Production (thousands of gallons)		
	Compression [2]	Absorption [3]	Charcoal	Compression [2]	Absorption [3]	Charcoal
Arkansas		8			32,096	
California	3	87		8,706	578,770	
Colorado	1	1		138	242	
Illinois	49	4		1,916	19,583	
Kansas	3	12		1,580	63,111	
Kentucky	1	3	1	2	9,070	467
Louisiana	3	24		5,013	108,728	
Michigan		3			3,919	
Montana		1			2,603	
New Mexico		7			55,713	
New York	1			17		
Ohio	4	7	1	37	6,580	1,445
Oklahoma	30	90		27,632	371,737	
Pennsylvania	71	11	1	2,180	13,117	74
Texas	51	123		246,852	685,188	
Utah					[4] 722	
West Virginia	49	22	5	14,869	41,056	2,857
Wyoming	3	4		23,230	10,150	
Total: 1940	269	407	8	332,172	2,002,385	4,843
1939	269	406	9	257,746	1,905,583	5,971

[1] Figures for 1941 not yet available.
[2] Includes cycling.
[3] Includes combination of absorption process with compression and charcoal processes.
[4] Drip gasoline.

TECHNOLOGIC DEVELOPMENTS

Cycling plants.—Cycling operations in Texas increased at a slower rate in 1941 than in 1940. The daily average volume of gas processed in December 1941 was 1,413 million cubic feet—a 14-percent gain over December 1940. The yield of liquid products represented a daily rate of 37,458 barrels in December 1941 and 22,357 barrels in December 1940. The gain in cycling operations was somewhat greater than the foregoing data indicate because some repressuring-plant statistics were included in December 1940 totals and omitted in 1941.

During 1941 the number of cycling and repressuring plants reporting to the Railroad Commission of Texas increased from 32 to 45. In Louisiana the largest cycling plant in the world began operating in July 1941 in the Cotton Valley field, Webster Parish, and construction of a second large plant was started in December 1941 at South Jennings, Jefferson Davis Parish. Construction has begun on a cycling plant in the Katy field, Waller County, Tex., which may surpass the Cotton Valley plant in volume of output.

Yields.—Minor reductions in yield of natural gasoline were reported in 1940 in all the prominent producing States except Illinois, where a slightly higher yield was obtained. The chief gains in production were in such States as Texas and Louisiana, where yields are below the national average owing partly to the low yields from cycling operations. The influence of these developments is expressed in a decline in average natural-gasoline yield in the United States from 1.01 gallons per thousand cubic feet of gas processed in 1939 to 0.95 gallon in 1940. Similar trends in production were evident in 1941 and are thought to have caused a further slight decline in average yields in that year.

Production by processes.—The total number of gasoline plants in 1940 was unchanged from 1939; the only shift was the net gain of one absorption plant and the loss in West Virginia of one charcoal plant. The gain of 11 compression (including cycling) plants reported in Texas was offset by the dismantling of 11 plants in 5 other States. In recent years, major changes in gasoline-plant facilities have been (1) a rapid increase in the number of plants in Texas and (2) notable decreases in Oklahoma, Pennsylvania, West Virginia, and Kansas.

Natural-gasoline production by compression plants is growing rapidly because of the cycling operations in Texas, which contribute a major part of such output. Production by the absorption process continues to expand moderately in all important producing States except California and Oklahoma, where failing gas supplies have restricted the throughput in certain important fields.

Trends in vapor pressures.—The average vapor pressure of all natural-gasoline shipments in 1941 was 19.7 pounds, up from the 1940 average of 19.3 pounds. The rise was due entirely to deliveries to refineries, which increased in vapor pressure to 20.6 pounds from 20.2 in 1940, while the vapor pressure of shipments to jobbers remained unchanged at 13.8 pounds.

Technical improvements.—Mounting demand for suitable components for blending into 100-octane aviation gasoline caused rapid development of "superfractionation" equipment capable of isolating such lighter-end hydrocarbons as isobutane and isopentane in relatively pure form. This requires expensive apparatus designed to control critical processing conditions of temperature, flow, and fluid levels with an exactitude heretofore unrealized in commercial installations.

A general trend toward maximum recovery of the lighter hydrocarbons by gasoline plants was evident in 1941. These are useful as aviation-gasoline components, either direct or after conversion by isomerization and/or alkylation.

LIQUEFIED PETROLEUM GASES

The unusually active market for liquefied petroleum gases that prevailed throughout 1939 and 1940 continued with increased momentum into 1941, when sales of 462,852,000 gallons were reported, a 48-percent gain over the 1940 total of 313,456,000 gallons. The 1941 volume of deliveries to consumers would, it is believed, have been even greater had equipment for handling and using liquefied petroleum gases been freely available and diversions for consumption as raw material in the manufacture of high-octane gasoline and other products been less of a factor. The phenomenal growth in the demand for this fuel can be realized better when it is noted that the annual sales have quadrupled in 5 years; furthermore, the 1941 total for each of the several gases under review, except pentane, is above the combined total for all liquefied gases reported as recently as 1936.

Sales of liquefied petroleum gases in the United States, 1935–41, in thousands of gallons

Year	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent of increase over preceding year
1935	34, 084	26, 814	13, 493	2, 464	76, 855	36.2
1936	40, 200	36, 502	27, 375	2, 575	106, 652	38.8
1937	45, 399	46, 474	46, 694	2, 833	141, 400	32.6
1938	52, 768	54, 130	56, 050	2, 253	165, 201	16.8
1939	71, 351	79, 323	69, 020	3, 886	223, 580	35.3
1940	77, 056	109, 216	123, 348	3, 836	313, 456	40.2
1941 [1]	112, 244	126, 969	219, 252	4, 387	462, 852	47.7

[1] Subject to revision.

All major demands for liquefied petroleum gases showed important gains in 1941 compared with 1940. Domestic requirements for cooking, water heating, and other household uses were 65 percent above the 1940 level compared with a 53-percent expansion in 1940 over 1939. A 41-percent increase in deliveries of liquefied petroleum gases for industrial fuel in 1941 compared with a 12-percent increment in 1940 largely reflects stepped-up defense activities. Gains in sales of liquefied petroleum gases to manufactured-gas companies and to chemical manufacturers—25 and 28 percent, respectively—are slightly below comparative percentage increases for the same industries in 1940. The outstanding spurt (81 percent) in the demand for liquefied petroleum gases to be used as internal-combustion-engine fuel in 1940 was not repeated in 1941—probably due partly to diversion of butane to other channels and to the question of future supply—and the volume of sales for the purpose exceeded the 1940 total by only 24 pe·cent.

Butane deliveries made up about one-quarter (24 percent) of the the total sales of liquefied petroleum gases in 1941, or the same proportionate share as in 1940. The propane total declined from 35 percent of all deliveries to 27 percent in 1941, and a corresponding gain (from 39 percent in 1940 to 47 percent in 1941) is found in the relative quantity of butane-propane mixtures reported. The decline in the proportionate volume of propane in the 1941 sales of liquefied petroleum gases is logical when it is considered that deliveries of propane gained only 16 percent compared with a 78-percent increase in the market for butane-propane mixtures. The bulk of propane requirements (77 percent in 1941) is reported for domestic use, where the unit of delivery is small and where consequently new customers, although numerous, add relatively little to the annual demand. On the other hand, the larger share of butane-propane mixtures is credited to the manufacturing and chemical industries and to motor-fuel demand, where requirements of individual consumers are proportionately large and fewer accounts can add materially to the total. It is believed, therefore, that the percentage of butane-propane mixtures in the annual sales probably will expand and the relative propane total will decline. The pentane item represents a very small part of the liquefied-petroleum-gas demand; furthermore, its proportionate share of the

total has dropped from about 2 percent in 1939 to less than 1 percent in 1941.

The marketed production of butane increased from 77,056,000 gallons in 1940 to 112,244,000 in 1941, or 46 percent, compared with a below-normal gain of 8 percent in 1940. Greatly increased demands for butane for domestic consumption (59 percent over 1940 requirements), industrial fuel (41 percent over 1940), and internal-combustion-engine fuel (67 percent higher than in 1940) were all important factors that caused the sharp rise in butane sales during 1941.

The demand for propane increased 16 percent—from 109,216,000 gallons in 1940 to 126,969,000 in 1941. The annual percentage gain for propane has declined noticeably for the third consecutive year from an increase of 47 percent in 1939 over 1938 to 38 percent in 1940 over 1939 and the still smaller increment in 1941 over 1940. Propane is used principally as a domestic fuel, a field in which the possibilities for great annual increases are less than for butane and butane-propane mixtures which go mostly to large-quantity consumers, such as industrial and chemical plants, and for motor-engine fuel. A 50-percent decline in demand for propane as an industrial fuel in 1941 (16,730,000 gallons in 1941 compared with 33,122,000 in 1940) reflects a reasonable shift to butane and butane-propane mixtures, fuels that are cheaper, that have higher B. t. u. content per gallon, and that can be handled at lower pressures. The unusual increase in quantity of propane reported under "All other uses" for the Pacific Coast area (2,329,000 gallons in 1941 and no deliveries in 1940) is said to be gas delivered to various Army camps for fuel purposes. It is known that a similar demand has developed in other areas, but the volume evidently has been reported under domestic use.

An unusually high gain in sales of butane-propane mixtures in 1940 was repeated in 1941, and deliveries increased from 123,348,000 gallons in 1940 to 219,252,000, or 78 percent. The quantity of butane-propane mixtures reported for domestic use more than doubled (increasing from 43,133,000 gallons in 1940 to 87,673,000 in 1941) and the total was not far below the total for propane, the liquefied petroleum gas generally associated with the domestic trade. Butane-propane mixtures sold for industrial fuel increased from 3,508,000 gallons in 1940 to 35,287,000 in 1941. Butane-propane mixtures evidently are replacing butane as industrial fuel, because greater quantities of the latter gas are now being diverted for raw material and blending agents in the making of various products. Chemical plants use important amounts of butane-propane mixtures in their processes, and this demand increased from 30,636,000 gallons in 1940 to 39,243,000 in 1941, or 28 percent. An unusually large volume of butane-propane mixtures was reported under "All other uses" in the Pacific Coast area; it is believed to cover deliveries to Army camps and defense housing projects, as is true of propane already mentioned.

The market for pentane increased 14 percent from 3,836,000 gallons in 1940 to 4,387,000 in 1941. Pentane is used chiefly by chemical-manufacturing establishments as raw material; however, the proportionate share for this purpose declined from 79 percent of the total in 1940 to 72 percent in 1941, whereas the demand for domestic use increased from 17 to 26 percent of total pentane deliveries.

Sales of liquefied petroleum gases in the United States, 1940–41, by uses, methods of transportation, and regional distribution, in thousands of gallons

	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent
1940						
By uses:						
Domestic	21,302	68,927	43,133	656	134,018	42.7
Gas manufacturing	10,847	5,201	4,191	46	20,285	6.5
Industrial fuel	33,166	33,122	3,508	96	69,892	22.3
Chemical manufacturing	10	987	30,636	3,038	34,671	11.1
Internal-combustion-engine fuel	11,242	915	41,761		53,918	17.2
All other uses	489	64	119		672	.2
	77,056	109,216	123,348	3,836	313,456	100.0
Percent of total	24.6	34.8	39.4	1.2	100.0	
By methods of transportation:						
Bulk	74,828	55,218	111,543	3,588	245,177	78.2
Cylinders and drums	2,228	53,998	11,805	248	68,279	21.8
	77,056	109,216	123,348	3,836	313,456	100.0
Regional distribution:						
Pacific Coast area	18,675	9,088	44,834		72,597	23.2
All other areas	58,381	100,128	78,514	3,836	240,859	76.8
	77,056	109,216	123,348	3,836	313,456	100.0
1941 [1]						
By uses:						
Domestic	33,873	98,048	87,673	1,128	220,722	47.7
Gas manufacturing	12,152	6,678	6,368	57	25,255	5.5
Industrial fuel	46,677	16,730	35,287	34	98,728	21.3
Chemical manufacturing	289	1,528	39,243	3,146	44,206	9.6
Internal-combustion-engine fuel	18,799	1,631	46,441		66,871	14.4
All other uses	454	2,354	4,240	22	7,070	1.5
	112,244	126,969	219,252	4,387	462,852	100.0
Percent of total	24.3	27.4	47.4	0.9	100.0	
By methods of transportation:						
Bulk	111,109	55,398	202,579	4,083	373,169	80.6
Cylinders	1,135	71,571	16,673	304	89,683	19.4
	112,244	126,969	219,252	4,387	462,852	100.0
Regional distribution:						
Pacific Coast area	26,628	14,006	62,251		102,885	22.2
All other areas	85,616	112,963	157,001	4,387	359,967	77.8
	112,244	126,969	219,252	4,387	462,852	100.0

[1] Subject to revision

In reviewing the relative quantities of the several liquefied petroleum gases delivered to satisfy the various uses, it should be noted that the proportion of butane in the domestic total was approximately 16 percent in both 1940 and 1941; the share of the domestic trade supplied by propane was 44 percent in 1941 compared with 51 percent in 1940 and a compensating gain was reported for butane-propane mixtures. This shift in kinds of liquefied gases sold for household fuel undoubtedly was due in part to the installation in the South Central States of numerous underground systems handling butane-propane mixtures for domestic use.

The manufactured-gas companies show proportionately more butane-propane mixtures and less butane in their purchases of liquefied petroleum gases in 1941 than in 1940. The butane share of such total requirements dropped from 53 percent in 1940 to 48 percent in 1941; most of this was compensated by the gain in butane-propane mixtures and the rest by propane deliveries.

Butane sold for industrial fuel was constant at about 47 percent of the total requirements for this use in both 1940 and 1941. Propane credited to industrial plants declined from 47 percent of the total in 1940 to 17 percent in 1941, but a corresponding gain (from 5 percent in 1940 to 36 percent in 1941) was reported for butane-propane mixtures in this particular use. Suppliers were believed to have been endeavoring to step up the volume of liquefied petroleum gases intended for industrial fuel by furnishing butane-propane mixtures, as they require less purification and consequently can be sold more cheaply. The demand for butane for other uses was another factor that caused more butane-propane mixtures to be used by industrial plants as fuel.

Liquefied petroleum gases credited to chemical plants for use as blending agents and raw material showed little change in their relative proportions in 1940 and 1941. Butane-propane mixtures comprised about 89 percent of the total in each year, and the rest was mainly pentane. Butane-propane mixtures are used widely as internal-combustion-engine fuel; however, the proportion of the total for mixtures dropped from 77 percent in 1940 to 69 percent in 1941, and most of the corresponding gain is found in the butane column and in a small increase for propane.

The following summary covering the distribution of liquefied petroleum gases by manufactured-gas companies in 1941 has been furnished through the courtesy of the American Gas Association.

At the end of 1941, liquefied petroleum gas was being delivered through mains to consumers in 175 communities in 31 States by 90 companies supplying 65,300 customers.

Butane-air gas with a heating value ranging from 520 to 1,300 B. t. u. per cubic foot was supplied to 142 communities in 30 States by 73 companies. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B. t. u. per cubic foot was supplied to 16 communities in Arizona, California, and Nevada by 7 companies. Undiluted propane gas with a heating value of 2,550 B. t. u. per cubic foot was supplied to 19 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia, and Wisconsin by 6 companies.

There has been a decided trend in recent years toward bulk handling of liquefied petroleum gases, because of the rapid growth in the proportion of deliveries to gas-manufacturing, industrial, and chemical plants and the motor-fuel trade, users that receive virtually all their requirements in tank cars or tank trucks. Bulk shipments of liquefied petroleum gases increased from 245,177,000 gallons in 1940 (78 percent of total sales) to 373,169,000 gallons in 1941 (approximately 81 percent of all deliveries), whereas cylinder shipments (limited largely to the domestic trade) were 68,279,000 gallons in 1940 and 89,683,000 in 1941. Ninety-six percent of all cylinder sales were credited to the domestic or "bottled-gas" market in 1941 compared with 97 percent in 1940.

The Pacific Coast marketing area (California, Oregon, Washington, Arizona, and Nevada) reported the sale of 102,885,000 gallons, or 22 percent of total national deliveries, in 1941 compared with 72,597,-000 in 1940, or 23 percent of all sales. Liquefied petroleum gases delivered in "All other areas" increased from 240,859,000 gallons in 1940—77 percent of total deliveries—to 359,967,000 in 1941—78 percent of the national demand.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

SUMMARY

The carbon-black industry experienced a profitable year in 1941, as new peaks were recorded for both production and sales. Because

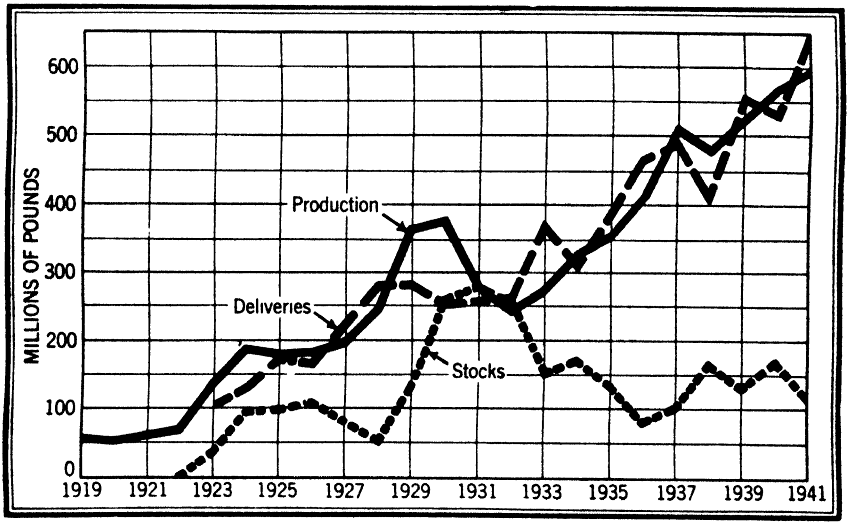

Figure 1.—Production, stocks, and deliveries of carbon black, 1919–41.

of the war, exports continued to decline but domestic sales advanced sharply. By the time the rubber shortage began to affect the market, other defense industries took up the slack, resulting in a 30-percent drop in producers' stocks between January 1 and December 31 (see fig. 1).

Prices were advanced on April 1 and July 1, then held firm until January 1, 1942, when there was another advance.

The use of carbon black is increasing in reducing glare on airport runways, in making black-out materials, and for military purposes; but in 1941, as in former years, the rubber industry was the largest user, taking almost 90 percent of domestic sales.

Salient statistics of carbon black produced from natural gas in the United States, 1937–41

	1937	1938	1939	1940	1941
Number of producers reporting	24	24	22	22	21
Number of plants	57	55	49	51	49
Quantity produced:					
By States and districts:					
Louisiana ... pounds	66,381,000	39,534,000	51,734,000	55,610,000	78,050,000
Texas:					
Panhandle district ... do	405,247,000	382,369,000	410,130,000	423,908,000	415,001,000
Rest of State ... do	15,821,000	34,735,000	43,044,000	55,987,000	65,211,000
Total Texas ... do	421,068,000	417,104,000	453,174,000	479,895,000	480,212,000
Other States ... do	23,157,000	20,401,000	20,258,000	33,287,000	35,803,000
Total United States ... do	510,606,000	477,039,000	525,166,000	568,792,000	594,065,000
By processes:					
Channel process ... do	444,427,000	441,284,000	464,588,000	491,765,000	487,967,000
Other processes [1] ... do	66,179,000	35,755,000	60,578,000	77,027,000	106,098,000
Stocks held by producers Dec. 31 ... pounds	100,497,000	166,159,000	130,792,000	169,587,000	118,847,000
Losses ... do	76,000	[2] 65,000	...	223,000	61,000
Quantity sold:					
Domestic deliveries:					
To rubber companies ... do	269,584,000	217,231,000	316,621,000	310,179,000	439,502,000
To ink companies ... do	18,116,000	14,131,000	21,929,000	24,159,000	28,198,000
To paint companies ... do	6,159,000	4,229,000	6,382,000	6,806,000	5,840,000
For miscellaneous purposes [3] ... pounds	11,503,000	7,883,000	11,773,000	11,012,000	[3] 58,469,000
Total domestic deliveries [3] ... pounds	305,362,000	243,474,000	356,705,000	352,156,000	[3] 532,009,000
Export ... do	184,253,000	167,968,000	203,828,000	177,618,000	[4] 112,735,000
Total sold ... do	489,615,000	411,442,000	560,533,000	529,774,000	644,744,000
Value (at plants) of carbon black produced.					
Total	$17,389,000	$11,486,000	$12,857,000	$16,510,000	$19,341,000
Average per pound ... cents	3.41	2.41	2.45	2.90	3.26
Estimated quantity of natural gas used ... M cubic feet	341,085,000	324,950,000	347,270,000	368,802,000	365,377,000
Average yield of carbon black per M cubic feet ... pounds	1.50	1.47	1.51	1.54	1.63
Average value of natural gas used per M cubic feet ... cents	1.26	.89	.94	1.00	1.13

[1] Lewis, roller, "special," and thermatomic.
[2] Gain.
[3] Exports for October to December 1941 included under "Miscellaneous purposes" to avoid disclosing export figures.
[4] Figures cover January to September, inclusive.

The following table shows data for carbon black produced from natural gas in the United States since 1919, the earliest year for which a canvass was made.

Summary of statistics for carbon black produced from natural gas in the United States, 1919–41

Year	Production (thousands of pounds)	Value (thousands of dollars)	Stocks at end of year (thousands of pounds)	Sales (thousands of pounds)		Average yield (pounds per M cubic feet of gas)
				Domestic	Export	
1919	52,057	3,816	(1)	(1)	(2)	1.04
1920	51,322	4,032	(1)	(1)	(2)	1.26
1921	59,766	5,446	(1)	(1)	(2)	1.18
1922	67,795	5,820	2,435	(1)	(2)	1.26
1923	138,263	11,692	38,321	[2] 102,210	(2)	1.27
1924	186,872	11,565	95,671	[2] 128,861	(2)	1.19
1925	177,417	9,640	96,023	132,449	43,183	1.26
1926	180,576	9,939	108,378	128,294	39,211	1.39
1927	198,429	10,955	82,831	168,999	54,431	1.38
1928	248,790	13,782	50,240	202,676	77,903	1.42
1929	366,442	18,720	132,203	191,977	91,829	1.40
1930	379,942	14,852	259,245	167,279	84,260	1.43
1931	280,907	8,621	280,010 [3] 281,667	161,712	96,714	1.44
1932	242,700	6,664	257,998	161,483	100,072	1.44
1933	273,125	7,602	155,969	222,182	152,286	1.44
1934	328,828	11,654	171,799	191,992	120,620	1.43
1935	352,749	13,755	136,086	245,351	142,185	1.46
1936	411,345	16,110	79,582	313,018	154,718	1.45
1937	510,606	17,389	100,497	305,302	184,253	1.50
1938	477,030	11,486	166,159	243,474	167,968	1.47
1939	525,166	12,857	130,792	256,705	203,828	1.51
1940	568,792	16,510	169,587	352,156	177,618	1.54
1941	594,065	19,341	118,847	[4] 532,009	[4 5] 112,735	1.63

[1] Figures not available.
[2] Exports not separately reported by the Department of Commerce before 1925
[3] For comparison with 1932.
[4] Exports for October to December included with domestic sales to avoid disclosing export figures.
[5] Figures cover January to September, inclusive

PRODUCTION

By States.—In 1941 Texas produced 480,212,000 pounds of carbon black, or slightly more than in the former peak year of 1940. A decline of 9,000,000 pounds in production in the Panhandle was offset by the gain in output in the rest of the State. Texas supplied 81 percent of the total United States output in 1941 compared with 84 percent in 1940. Louisiana continued its upward trend and produced 78,050,000 pounds in 1941 compared with 55,610,000 pounds in 1940. Kansas and Oklahoma combined made an output of 35,803,000 pounds in 1941, compared with 33,287,000 in 1940.

Carbon black produced from natural gas in the United States in 1941, by States and by major producing districts

State and district	Producers reporting[1]	Number of plants	Production: Pounds	Production: Value at plant: Total	Production: Value at plant: Average (cents)	Natural gas used: M cubic feet	Natural gas used: Average yield per M cubic feet (pounds)	Natural gas used: Value: Total	Natural gas used: Value: Average per M cubic feet (cents)
Kansas	2	2	35,803,000	$1,216,000	3.40	16,399,000	2.18	$296,000	1.80
Oklahoma	4	4							
Louisiana: Monroe-Richland district (Morehouse and Ouachita Parishes)	6	6	78,050,000	2,784,000	3.57	18,627,000	4.19	576,000	3.09
Texas:									
Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties)	17	29	415,001,000	13,239,000	3.19	292,628,000	1.42	2,995,000	1.02
Rest of State (Aransas, Nueces, Stephens, Ward, and Winkler Counties)	5	8	65,211,000	2,102,000	3.22	37,723,000	1.73	268,000	.71
Total Texas	[1] 17	37	480,212,000	15,341,000	3.19	330,351,000	1.45	3,263,000	.99
Total United States	[1] 21	49	594,065,000	19,341,000	3.26	365,377,000	1.63	4,135,000	1.13

[1] In counting the total number of producers reporting, a producer operating in more than 1 State, district, or county is counted but once

By months.—War demands evidently influenced production, as the highest daily average output (obtained by prorating the Bureau's annual total upon the basis of monthly figures of the National Gas Products Association) was for December; the lowest were those for May and July.

Carbon black produced from natural gas in the United States in 1941, by months, in pounds

Month	National Gas Products Association[1]	Bureau of Mines[2]: Total	Bureau of Mines[2]: Daily average
January	41,842,851	50,136,000	1,627,000
February	37,934,158	45,684,000	1,632,000
March	42,258,613	50,911,000	1,642,000
April	41,324,480	49,783,000	1,659,000
May	41,385,780	49,842,000	1,608,000
June	40,076,944	48,298,000	1,610,000
July	41,371,402	49,842,000	1,608,000
August	41,589,962	50,139,000	1,617,000
September	40,216,651	48,476,000	1,616,000
October	40,521,599	48,832,000	1,575,000
November	41,193,670	49,604,000	1,653,000
December	43,313,845	52,218,000	1,684,000
	493,029,955	594,065,000	1,628,000

[1] Represents output of contact black.
[2] Monthly figures obtained by allocating the Bureau's annual total proportionately to the association's monthly data

Methods and yields.—Although the leading method of producing carbon black is still the channel process, the other processes—Lewis, roller, "special," and thermatomic—are gaining importance; they produced 18 percent of the total output in 1941 compared with 14 percent in 1940 and 12 percent in 1939. The principal gain was

made by the furnace or high-yield blacks; hence, the average yield rose to 1.63 pounds a thousand cubic feet of gas used compared with 1.54 pounds in 1940.

Number of plants.—There were 49 plants in operation in 1941 compared with 51 in 1940; 2 new plants were built, and 4 that produced in 1940 were not operated in 1941. Publication of information relative to location and capacity of plants has been suspended.

Producers.—The Reliance Carbon Co. was dissolved in 1941. No new names were added to the list of producers.

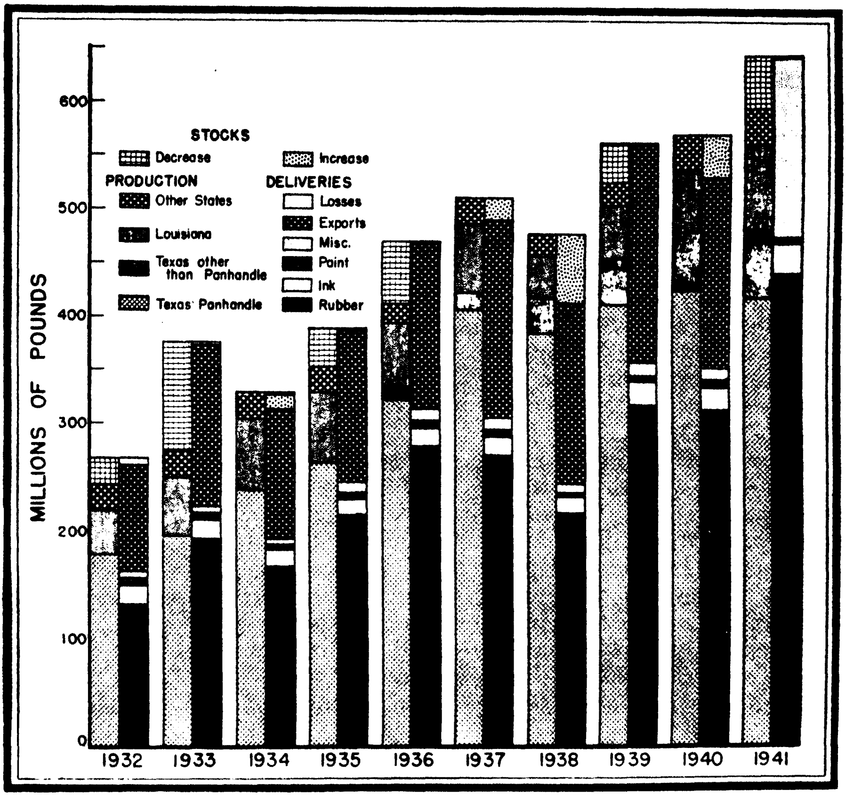

FIGURE 2.—Production and consumption of carbon black, 1932–41. Production in "Texas other than Panhandle" included in "Other States," 1932–35. Exports for 1941 included in "Miscellaneous."

DEMAND

Total deliveries.—Sales of carbon black, as reported by producers, were 644,744,000 pounds in 1941—22 percent above the 1940 figure of 529,774,000 pounds.

Domestic consumption.—Domestic sales increased in all major classes except those to paint companies. Because publication of exports for October, November, and December 1941 has been suspended, exports for the entire year 1941 have been combined in figure 2 with sales for miscellaneous purposes. It is not possible to compare relative sales of the major classes in 1941 with those in 1940.

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Reports from producers indicate that domestic sales in 1941 were divided as follows: Rubber companies, 439,502,000 pounds; ink companies, 28,198,000 pounds; paint companies, 5,840,000 pounds; miscellaneous purposes, including 3 months' exports, 58,469,000 pounds.

According to information supplied by the Bureau of Foreign and Domestic Commerce, the consumption of rubber, both at home and abroad, increased sharply in 1941.

Consumption of rubber in the United States reached a new peak, with substantial gains in all three types—crude, reclaimed, and synthetic. Statistics of the Rubber Manufacturers Association indicate that the percentage of decrease in stocks at the end of 1941 far outweighed the gain in number of tire casings produced, showing an increased demand made by the war on other branches of the rubber industry that use carbon black. The increased use of retread for tires is reflected in a sharp rise in the production of camelback. As this has a relatively high carbon-black content, it was probably also a factor in the 42-percent increase in the quantity of carbon black delivered to rubber companies during 1941.

A 17-percent increase in the quantity of carbon black delivered to ink companies is confirmed by information supplied by the Bureau of Foreign and Domestic Commerce, which shows new gains in newsprint available for consumption in 1941.

A 14-percent decrease in carbon black delivered to paint companies seems to indicate that its use in black-out paints did not affect the trade in 1941.

Exports and imports.[1]—Exports for the first 9 months of 1941 totaled 112,734,841 pounds, valued at $5,104,509; comparison with the corresponding period of 1940 shows a marked decline in shipments to foreign countries. The foregoing figures indicate an average value of 4.53 cents in 1941 compared with 4.38 cents in 1940. Publication of export figures for October, November, and December, and of the names of importing countries, has been suspended.

Imports of gas black for the first 9 months of 1941 were only 800 pounds, valued at $101. Imports of acetylene black (all from Canada) for the 9 months were 2,907,751 pounds, valued at $310,084.

Carbon black exported from the United States, 1940–41, by months

Month	1940		1941 (Jan.-Sept.)	
	Pounds	Value	Pounds	Value
January	20,109,979	$874,658	9,800,208	$454,687
February	22,885,685	1,034,505	9,092,813	384,618
March	27,026,918	1,189,390	12,183,017	538,411
April	15,023,991	650,748	11,038,325	508,468
May	8,464,702	381,735	15,028,478	683,493
June	11,862,418	503,178	7,100,275	296,292
July	19,116,627	811,861	14,863,785	670,866
August	8,954,840	394,645	11,157,609	503,884
September	10,274,304	452,298	22,470,331	1,061,790
October	13,579,306	632,906	(1)	(1)
November	10,707,700	489,704	(1)	(1)
December	9,611,397	408,192	(1)	(1)
	177,617,867	7,823,820	112,734,841	5,104,509

1 Publication suspended.

1 Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

STOCKS

Favorable market conditions in 1941 were reflected in a 30-percent decrease in producers' stocks between January 1 and December 31. Stocks on hand at the end of the year were 118,847,000 pounds—the lowest figure since 1937, when 100,497,000 pounds were reported.

PRICES AND VALUES

The average value of carbon black at the plants rose from 2.90 cents a pound in 1940 to 3.26 cents in 1941.

The following table gives spot prices of representative grades of carbon black in 1941, as quoted by the Oil, Paint and Drug Reporter.

Quoted prices on various grades of carbon black in carlots in 1941, in cents a pound

[Oil, Paint and Drug Reporter]

Date	Regular, uncompressed, bags, f.o.b. plants	Beads, compressed, bags, f.o.b. plants	Bulk, cars	
			F. o. b. plants	F. o. b. N. Y. harbor
January 1	3 075	2. 925	2. 75	3. 63
April 1	3 325	3 175	3. 00	3. 97
July 1	3. 425	3. 350	3. 15	(1)
Average	3. 314	3. 202	3. 01	(1)

[1] Not quoted after April 1

HELIUM

By H. S. Kennedy and R. A. Cattell

SUMMARY OUTLINE

Introduction.—Planning and research by Bureau of Mines engineers, extending without interruption since the First World War, have resulted in a helium project that plays an important role in the present emergency. About 1925 the Bureau initiated (1) an accelerated program of research on properties of gases suitable for extraction of helium and (2) engineering studies of fields found in the course of the survey of helium-bearing natural gas that offered possibilities for economical extraction of helium. A successful helium project not only requires a supply of natural gas of suitable helium content but also a large proved reserve under a pressure of several hundred pounds per square inch (which can be protected against waste or rapid depletion through excessive withdrawals), an adequate and dependable outlet for the residue gas from the helium plant, and various other conditions essential to successful and economical extraction of helium.

The Cliffside field near Amarillo, Tex., was selected for a helium project and has proved to be the best source of helium-bearing natural gas found in 25 years of concentrated search. All gas rights were acquired in 50,000 acres of land covering the field, equipment using a new method for extraction of helium was designed, and the Amarillo Helium Plant (with a rated annual capacity of 24 million cubic feet of helium) was built in 1929.

Expanded program.—The importance of helium to the national defense program was recognized by the Congress in appropriating $175,000 in an act approved April 1, 1941, to be used in a survey of sources of helium for new helium plants and for additions to the existing facilities near Amarillo. With the funds made available, the Bureau is collecting and analyzing samples from various gas fields and studying geological and engineering features of fields that offer possibilities for production of helium. The primary purpose of this work is to acquire data that will aid in developing plans for increasing the output of helium to meet any helium requirements that may arise in the future. Moreover, at the end of the fiscal year 1941, the Congress appropriated $350,000 for another unit at the two-unit Amarillo plant and for drilling additional wells, thereby increasing the rated annual capacity of that plant to 36 million cubic feet. The new unit and other facilities being constructed near Amarillo will be ready for operation at the beginning of the fiscal year 1943.

The plans of the Army and Navy have progressed to such a point that the expanded facilities at the Amarillo plant will not supply enough helium for the war program. Therefore, the Congress made an additional $1,250,000 available to the Bureau of Mines for new helium-producing facilities. As a result of the survey and engineering studies, the Channing area in the southwestern part of the main Panhandle field (Moore, Potter, Oldham, and Hartley Counties, Tex.), which produces gas with an average helium content of about 1 percent, was selected as a source of helium-bearing natural gas. A site at Exell, Tex., has been selected for a new helium plant, to be constructed with a rated annual capacity of 24 million cubic feet of helium. A contract permitting the Bureau to process the gas from this area for helium extraction and contracts for the design and construction of a new plant have been executed.

Protection of plant and gas field.—Helium is used to inflate aircraft that patrol the coasts. The Amarillo plant is the only operating helium plant in the world, and the Cliffside gas field is therefore an essential war area as the source of helium-bearing natural gas. The military authorities and the Federal Bureau of Investigation have cooperated with the Bureau of Mines in studying means of protecting the plant, pipe line, and gas wells, and their recommendations for guarding the properties against sabotage have been put into effect.

Operation of Amarillo plant.—During the fiscal year ended June 30, 1941, the Bureau of Mines Amarillo Helium Plant operated at a rate higher than in any previous year and produced 16,173,430 cubic feet of helium; the cumulative output from April 1929 to June 30, 1941, was 116,165,430 cubic feet. During the first half of the fiscal year ended June 30, 1942, 15,721,950 cubic feet of additional helium were produced, raising the plant's total output from April 1929 to December 31, 1941, to 131,887,380 cubic feet. This quantity of helium, added to the 49 million cubic feet produced at the Fort Worth plant before the Amarillo plant was built, raises the total production in Government plants to approximately 180 million cubic feet at the end of the calendar year 1941.

Residue natural gas from the helium plant sold for use as fuel in the fiscal year 1941 totaled 845,728,000 cubic feet and brought a return of $38,057. The cumulative sales of residue gas for the 12-year operating period at the Amarillo plant (to June 30, 1941) totaled 5,997,936,000 cubic feet, for which $305,037 was received.

Cliffside gas field.—In the fiscal year 1941, 951,031,000 cubic feet of helium-bearing natural gas were produced by the Bureau of Mines from the Government's Cliffside gas field to supply the Amarillo plant; the cumulative output of natural gas from the field is 6,934,920,000 cubic feet.

The Bureau began a drilling program in the Cliffside field for a supply of gas in addition to that from the five wells drilled before 1941. Contracts were let for four wells, which were completed with daily open flows ranging from 11 to 22 million cubic feet of gas. Gathering lines were constructed to connect the wells to the main pipe line.

Government use of helium.—The Navy, which continued to purchase the largest volume of helium, received about 7 million cubic feet during the fiscal year 1941. Increased volumes of helium are used for inflating lighter-than-air craft to meet the expanding program of coast patrol. Helium is used for diverse fleet operations, including admix-

ture with oxygen to provide a breathing atmosphere that mitigates caisson disease (the "bends") in diving; the Bureau made pioneering experiments in this field in 1923.

The Weather Bureau consumed about 3,700,000 cubic feet of helium during the fiscal year 1941—over 40 percent more than in the fiscal year 1940. This increase was due to establishment of new meteorological stations and reflects the increased operations to supply the military services with weather data for extended war activities.

The Army employs helium principally for inflating barrage balloons, which are used in the rapidly expanding program of training soldiers to operate this type of war weapon for protecting military objectives from bombing. It is probable that barrage balloons flown above most objectives will be filled with hydrogen, but helium may be used where severe fire hazards will arise from hydrogen-filled balloons that may be shot down in flames. The extent to which helium will be employed in actual barrage-balloon operations will depend on future developments.

Sales of helium for medical, scientific, and commercial use.—Public sale of helium was authorized by the amendatory Helium Act approved September 1, 1937. To June 30, 1941, 124 contracts for a total of 2,761,095 cubic feet of helium had been approved. In the fiscal year 1941, 1,246,940 cubic feet of helium (7.7 percent of the production) were sold to non-Government users. About 600,000 cubic feet were employed for medical use, for an estimated 50,000 hours of treatment.

New uses for helium center around developments in metallurgy. Helium is being used as an inert atmosphere for welding magnesium-alloy wings for war planes, and this development has speeded their manufacture. Another use of helium in the national war program is to provide an inert atmosphere for welding defects in magnesium-alloy castings. It is reported that this use of helium has accelerated the production of magnesium castings.

Prices.—The estimated cost of producing helium for the fiscal year 1941, as approved by the Secretary of the Interior, was $13.75 a thousand cubic feet. In accordance with the law and regulations, this estimate was used as the basis for computing the deposits made by non-Government buyers of helium. Increased volume of output has a marked effect in reducing the unit cost of helium. Although production in the fiscal year 1941 was 71 percent more than that in 1940, the decrease in the unit cost was much less than it would have been in normal times because new obligations were incurred for protecting the helium properties against sabotage. The actual selling prices for the fiscal year 1941, as approved by the Secretary of the Interior, were $9.75 for helium for medical use, $10.24 for helium for scientific use, and $11.47 for helium for commercial use. The balances of the deposits under sales contracts, in excess of the total charges for helium and services applicable to the contracts, were refunded to the purchasers.

Government agencies were charged the record low price of $6.42 per thousand cubic feet, irrespective of the use made of the helium. This represents operating cost only, because under the law depreciation and depletion are not assessed against Government agencies.

The price at which helium can be sold is influenced by the volume of production and improvements in the process. Over a period of

years, the price of helium has shown a marked decrease. The trend in recent years is indicated by the following table:

Prices charged for 1,000 cubic feet of helium, 1938–41

[Exclusive of service charges]

	Fiscal year—			
	1938	1939	1940	1941
Helium requisitioned by Government agencies	$11.16	$11.47	$8.43	$6.42
Helium sold to non-Government purchasers.				
Medical use	13.471	12.80	11.17	9.75
Scientific use	13.471	13.44	11.73	10.24
Commercial use	15.088	15 05	13.14	11.47

Outlook and plans.—As most of the world is at war, the War and Navy Departments and the Weather Bureau have been obliged continually to expand their war plans involving the use of helium. The production in the fiscal year 1942 was nearly double that in the fiscal year 1941. The anticipated demand in the fiscal year 1943 will require the full rated annual capacity of 36 million cubic feet of helium from the three units at the Amarillo plant (including the new third unit) and large quantities from the new plant being constructed at Exell, Tex. The usefulness of the airship patrol in locating enemy submarines off the coasts has accelerated the program for constructing additional lighter-than-air craft, which, in turn, has increased the demand for helium. An increase in the annual capacity of the new plant at Exell, Tex., from the 24 million cubic feet originally contemplated to 60 million cubic feet is being considered.

Work is continuing on the survey of helium-bearing natural gas and the geological and engineering study of fields that give promise as sources of helium. This work will enable the Bureau of Mines to select areas for establishing new helium plants whenever they are needed to meet the requirements of war.

ASPHALT AND RELATED BITUMENS

By A. H. Redfield [1]

SUMMARY OUTLINE

SUMMARY

Refinery sales of petroleum asphalt (exclusive of road oil) to domestic consumers in the United States were 26 percent larger in tonnage in 1941 than in 1940, and, because of higher prices, they were 34 percent greater in total value. The average sales value per short ton increased 6 percent. To meet the augmented domestic demand, petroleum refineries enlarged their output 23 percent from 1940 to 1941 and decreased their stocks 1.6 percent. The increased domestic demand in 1941 was partly met by imports,which were 18 percent higher in the first 9 months of the year than in the corresponding months of 1940. At the same time, foreign demand was 22 percent less in the first three quarters of 1941 than in the corresponding period of 1940.

The tonnage of bituminous rock sold had an even greater proportional increase—43 percent—than did the total tonnage of solid and liquid petroleum asphalt sold for paving purposes—23 percent. The comparatively low valued products of Texas, Oklahoma, and Alabama accounted for the greater increases in sales of bituminous rock; consequently, the total value of bituminous rock sold increased only 19 percent, and the average value per short ton sold decreased 17 percent.

In spite of a slight decline in exports of natural unmanufactured asphalt (mostly gilsonite), sales of gilsonite increased 14 percent in quantity from 1940 to 1941. As the unit value of the gilsonite sold declined 3 percent, the total sales value increased only 10.5 percent.

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—Bituminous rock shared the generally increased demand for asphaltic substances in 1941. Sales of rock asphalt by producers in the United States increased 43 percent in quantity—from 458,665 short tons in 1940 to 654,692 tons in 1941—and 19 percent in total value—from $1,949,166 to $2,312,227. Prices were lower than in 1940, and the average sales value at the mine decreased from $4.25 per ton to $3.53.

Operators in Texas and Oklahoma increased their sales from 282,250 tons valued at $833,248 to 446,432 tons valued at $1,197,319, but smaller sales in California more than offset an increase in Missouri.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

East of the Mississippi River, producers in Kentucky and Alabama enlarged their sales from 150,312 tons valued at $1,031,646 to 193,887 tons valued at $1,047,529.

Gilsonite and wurtzilite.—Greater demand in the domestic market boosted producers' sales of gilsonite in Utah from 31,930 short tons valued at $770,711 in 1940 to 36,407 tons valued at $851,623 in 1941. The average sales price per ton at the mine or railhead decreased from $24.14 to $23.39.

Sales of wurtzilite from Utah decreased from 70 tons valued at $5,460 in 1940 to 69 tons valued at $5,343 in 1941.

Sulfonated bitumen.—In 1941, as in 1940, a small quantity of natural sulfonated bitumen was produced in Box Elder County, Utah, near Ogden.

Exports.—Exports of natural unmanufactured asphalt were 8,223 short tons valued at $266,404 in the first 9 months of 1941, compared with 8,382 tons valued at $362,836 in the corresponding months of 1940. No data to indicate the destination of these exports in 1941 are available for publication.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Petroleum refineries in the United States produced 23 percent more asphalt in 1941 than in 1940. The Rocky Mountain district was the only exception to the general increase. The greatest gains in tonnage were made in the northeastern quarter of the United States and the Mid-Continent area; California and Gulf Coast refineries showed smaller increases.

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1941, by districts, in short tons

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, losses, and exports	Sales to domestic consumers
			Dec. 31, 1940	Dec. 31, 1941		
East Coast	2,138,000	148,600	137,000	120,000	137,800	2,165,800
Appalachian	258,000	300	13,000	13,000	8,900	249,400
Indiana, Illinois, Kentucky, etc	1,327,800	161,000	170,000	171,000	461,800	1,026,000
Oklahoma, Kansas, and Missouri	501,300	166,100	58,000	94,000	11,200	620,200
Texas:						
Gulf Coast	362,700	300	17,000	23,000	161,000	196,000
Inland	244,000	88,000	19,000	15,000	----------	336,000
Total Texas	606,700	88,300	36,000	38,000	161,000	532,000
Louisiana-Arkansas:						
Louisiana Gulf Coast	417,100	-------	51,000	47,000	57,200	363,900
Arkansas and Louisiana Inland	284,700	5,700	51,000	22,000	4,300	315,100
Total Louisiana-Arkansas	701,800	5,700	102,000	69,000	61,500	679,000
Rocky Mountain	134,400	44,300	20,000	27,000	10,500	161,200
California	889,600	38,800	78,000	72,000	139,300	795,100
Total United States:						
1941	6,557,600	653,100	614,000	604,000	992,000	6,228,700
1940	5,346,700	287,400	550,000	614,000	627,800	4,942,300

Sales of asphalt (exclusive of road oil) at petroleum refineries to domestic consumers in the United States, 1940–41, by districts

District	1940		1941	
	Short tons	Value	Short tons	Value
East Coast	1,725,036	$19,995,386	2,165,783	$24,799,304
Appalachian	171,001	1,972,721	249,362	3,071,753
Indiana, Illinois, Kentucky, etc	904,532	8,332,733	1,026,016	10,506,007
Oklahoma, Kansas, and Missouri	452,314	2,729,728	620,166	4,373,066
Texas:				
Gulf Coast	157,696	1,493,388	196,015	1,773,130
Inland	207,045	1,788,661	336,022	2,948,610
Total Texas	364,741	3,282,049	532,037	4,721,740
Louisiana-Arkansas:				
Louisiana Gulf Coast	309,646	2,829,484	363,885	3,496,201
Arkansas and Louisiana Inland	227,986	1,561,379	315,116	2,210,082
Total Louisiana-Arkansas	537,632	4,390,863	679,001	5,706,283
Rocky Mountain	133,940	946,789	161,200	1,492,574
California	653,093	3,540,782	795,158	5,842,416
Total United States	4,942,289	45,191,051	6,228,723	60,513,143

Stocks.—Throughout the Nation, stocks of petroleum asphalt at refineries decreased 10,000 short tons from December 31, 1940, to December 31, 1941, principally in Louisiana and Arkansas, the East Coast district, and California. On the other hand, refinery stocks increased in Oklahoma, Kansas, and Missouri; in the Rocky Mountain district; and in Texas.

Sales.—Sales of petroleum asphalt by refineries to domestic consumers in the United States increased 26 percent in quantity and 34 percent in total value from 1940 to 1941; the average value at the refinery increased from $9.14 to $9.72.

Of the total petroleum asphalt sold to domestic consumers, 25 percent was manufactured from foreign petroleum (imported chiefly from Venezuela and Mexico), the same percentage as in 1940. Although runs of foreign crude oil to stills increased 22 percent—from 41,798,000 barrels in 1940 to 50,946,000 barrels in 1941—sales of petroleum asphalt from this source increased 27 percent in tonnage during the same period; apparently, more foreign crude oil was run to asphalt in 1940 than in 1941. East Coast refineries sold 91 percent of the total asphalt made from foreign crude in 1940 and 97 percent in 1941.

Highway and street construction and airport-runway surfacing used (in the form of paving asphalt, paving flux, cut-back asphalts, and asphalt emulsions) 64 percent of the total asphalt sold to domestic consumers by petroleum refineries in 1941, compared with 66 percent in 1940. Such statistics as are available indicate a sharp increase in the construction of paved highways over 1940. Not only was more mileage of high-type roadway laid down by the States, but the Federal Government contributed generously to the enlarged demand for paving grades of asphalt in 1941 by its program of constructing paved streets for camps and cantonments and runways for airports.

Domestic sales of paving asphalt of less than 200 penetration increased from 1,277,961 short tons in 1940 to 1,764,221 tons in 1941, or 38 percent. The gains were general but were greatest in the three

northeastern districts, in Louisiana and Arkansas, and in California. It is noteworthy that the three northeastern refining districts, which produced 58 percent of the paving asphalt sold in the United States in 1941, laid 62 percent of the high-type surface constructed in that year, according to Engineering News-Record.

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1941, by varieties

[Value f. o. b. refinery]

Variety	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration:						
Asphalt for—						
Paving	1,178,332	$10,433,957	585,889	$6,667,974	1,764,221	$17,101,931
Roofing	856,610	8,048,283	255,077	2,907,963	1,111,687	10,956,246
Waterproofing	29,886	349,872	10,052	124,637	39,938	474,509
Blending with rubber	7,920	151,866	12,616	214,093	20,536	365,959
Briquetting	76,941	665,757	234	2,638	77,175	668,395
Mastic and mastic cake	2,220	38,836	9,693	127,347	11,913	166,183
Pipe coatings	39,561	482,195	2,328	32,564	41,889	514,759
Molding compounds	31,060	372,310	3,786	49,026	34,846	421,336
Miscellaneous uses	145,395	1,590,694	83,749	1,157,489	229,144	2,748,183
	2,367,925	22,133,770	963,424	11,283,731	3,331,349	33,417,501
Semisolid and liquid products of more than 200 penetration:						
Flux for—						
Paving	155,779	1,200,602	57,007	566,302	212,786	1,766,904
Roofing	472,345	3,013,232	87,664	1,038,338	560,009	4,051,570
Waterproofing	3,094	56,145	1,853	25,942	4,947	82,087
Cut-back asphalts:						
Rapid-curing	675,088	6,591,325	342,559	3,905,429	1,017,647	10,496,754
Medium-curing	802,403	7,003,345	83,082	1,034,382	885,485	8,037,727
Emulsified asphalts and fluxes	126,836	1,555,016	2,170	21,824	129,006	1,576,840
Paints, enamels, japans, and lacquers	31,559	470,042	13,479	214,268	45,038	684,310
Other liquid products	41,189	384,738	1,267	14,712	42,456	399,450
	2,308,293	20,274,445	589,081	6,821,197	2,897,374	27,095,642
Total						
1941	4,676,218	42,408,215	1,552,505	18,104,928	6,228,723	60,513,143
1940	3,719,218	31,267,837	1,223,071	13,923,214	4,942,289	45,191,051

Paving asphalt sold at petroleum refineries in the United States, 1940–41, by districts, in short tons

District	1940	1941
East Coast	609,717	779,923
Appalachian	31,270	66,940
Indiana, Illinois, Kentucky, etc	110,762	178,549
Oklahoma, Kansas, and Missouri	31,753	36,526
Texas:		
Gulf Coast	26,029	45,575
Inland	58,499	64,361
Total Texas	84,528	109,936
Louisiana-Arkansas		
Louisiana Gulf Coast	118,586	145,953
Arkansas and Louisiana Inland	87,632	143,562
Total Louisiana-Arkansas	206,218	289,515
Rocky Mountain	8,165	26,773
California	195,548	276,059
Total United States	1,277,961	1,764,221

Increased construction of lighter-type asphaltic highways is indicated by greater sales of cut-back asphalts than in 1940. Total sales of rapid-curing and medium-curing cut-backs increased 10 percent in quantity—from 1,722,475 to 1,903,132 tons. The greatest gains were in the East Coast district, the Oklahoma-Kansas-Missouri district, the Louisiana-Arkansas district, Texas, and the Rocky Mountain district. Against these gains were a sharp decline in the Indiana-Illinois-Kentucky-etc. district and smaller declines in California and the Appalachian district. Most of the gain in sales of cut-back asphalts was in the medium-curing type, and the greatest increases in that type were in the East Coast and Oklahoma-Kansas-Missouri districts.

Cut-back asphalts sold at petroleum refineries in the United States, 1940–41, by districts, in short tons

District	1940	1941
East Coast	449,368	576,779
Appalachian	50,940	46,526
Indiana, Illinois, Kentucky, etc	340,173	280,437
Oklahom a, Kansas, and Missouri	253,039	323,115
Texas:		
Gulf Coast	73,908	75,305
Inland	48,520	65,753
Total Texas	122,428	141,058
Louisiana-Arkansas:		
Louisiana Gulf Coast	125,738	143,544
Arkansas and Louisiana Inland	45,835	48,507
Total Louisiana-Arkansas	171,573	192,051
Rocky Mountain	100,634	114,739
California	234,320	228,427
Total United States	1,722,475	1,903,132

Petroleum refineries sold 85,570 short tons (20,162,003 gallons) of emulsified asphalts and fluxes valued at $887,202 in 1940 and 129,006 tons (30,396,265 gallons) valued at $1,576,840 in 1941; in addition, 45,924,626 gallons valued at $3,385,468 in 1940 and 76,830,549 gallons valued at $6,919,102 in 1941 were sold by major industrial companies that purchased asphalt from petroleum refineries. Accordingly, total known sales of emulsified asphalts and fluxes increased 62 percent in quantity—from 66,086,629 to 107,226,814 gallons—and 99 percent in value—from $4,272,670 to $8,495,942.

Roofing manufacture made the second-largest demand for asphalt, absorbing 25 percent of the sales to domestic consumers in 1940 and 27 percent in 1941. Although shipments of prepared roofing and asphalt siding reported to the Bureau of the Census increased 29 percent—from 34,222,039 squares in 1940 to 44,112,699 squares in 1941—domestic sales of roofing asphalt and roofing flux combined increased 37 percent—from 1,218,695 to 1,671,696 tons. Some roofing and asphalt siding, however, is made by petroleum refiners who do not report their consumption of asphalt for roofing manufacture among their sales. The increase in sales of roofing asphalt and flux was general. The principal gain was in the northeastern quarter of the United States—notably in the East Coast and Indiana-Illinois-Kentucky-etc. districts. Substantial gains occurred also in the Oklahoma-

Kansas-Missouri district, in Inland Texas, in Inland Louisiana and Arkansas, and in California.

Roofing asphalt and flux sold at petroleum refineries in the United States, 1940–41, by districts, in short tons

District	1940	1941
East Coast	410,728	513,927
Appalachian	76,000	120,515
Indiana, Illinois, Kentucky, etc.	289,598	430,365
Oklahoma, Kansas, and Missouri	80,552	136,196
Texas:		
Gulf Coast	31,556	35,603
Inland	47,098	79,652
Total Texas	78,654	115,255
Louisiana-Arkansas:		
Gulf Coast	32,443	32,757
Arkansas and Louisiana Inland	85,049	116,142
Total Louisiana-Arkansas	117,492	148,899
Rocky Mountain	1,552	3,789
California	164,119	202,750
Total United States	1,218,695	1,671,696

FOREIGN TRADE

Imports.—Imports of natural asphalt and bitumen into the United States during the first 9 months of 1941 totaled 8,866 short tons valued at $118,061 compared with 10,313 tons valued at $120,163 in the corresponding months of 1940. For the same periods, imports of lake asphalt from Trinidad declined from 7,949 tons valued at $81,353 in 1940 to 6,017 tons valued at $66,323 in 1941. On the other hand, imports of grahamite from Cuba increased from 1,914 tons valued at $33,907 in the first three-quarters of 1940 to 2,774 tons valued at $47,813 in the corresponding period of 1941.

Imports of solid petroleum asphalt decreased from 30,230 short tons valued at $168,006 in the first 9 months of 1940 to 18,987 tons valued at $64,806 in the corresponding months of 1941. From January to September 1940, Netherlands West Indies supplied 28,517 tons valued at $115,207 and Mexico 1,632 tons valued at $51,350.

In addition, Mexico supplied 152,320 barrels (27,695 short tons) of liquid petroleum asphalt, including cut-backs and road oil, valued at $127,949 during the first three quarters of 1940 and 291,531 barrels (53,006 tons) valued at $352,220 during the corresponding quarters of 1941.

Exports.—Exports of petroleum asphalt decreased from 209,581 short tons valued at $3,194,981 in the first 9 months of 1940 to 163,461 tons valued at $2,500,001 in the corresponding months of 1941. No data to indicate the destination of exports during the first three quarters of 1941 are available for publication.

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States increased from 5,279,056 short tons in 1940 to 6,722,832 tons in 1941, according to freight-

commodity statistics compiled by the Interstate Commerce Commission. The increase was general; but the largest gains were in terminations by railroads of the Eastern district, operating east of the Mississippi and Illinois Rivers and north of the Ohio and Potomac Rivers. West of the Mississippi River the gains were greatest in the Central Western region, bounded by Chicago, Peoria, St. Louis, Kansas City, El Paso, the boundary with Mexico, and Portland, Oreg.

Asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States, 1940–41, by districts and regions, in short tons

District and region	1940	1941
Eastern district:		
New England region	205,093	301,764
Great Lakes region	1,088,482	1,482,260
Central Eastern region	1,360,132	1,827,661
Total Eastern district	2,653,707	3,611,685
Southern district:		
Pocahontas region	166,738	199,807
Southern region	688,415	862,275
Total Southern district	855,153	1,062,082
Western district:		
Northwestern region	538,028	585,743
Central Western region	924,705	1,109,322
Southwestern region	307,463	354,000
Total Western district	1,770,196	2,049,065
Total United States	5,279,056	6,722,832

ROAD OIL

Refinery sales of road oil to domestic consumers increased 5 percent in quantity—from 8,444,000 barrels in 1940 to 8,831,000 barrels in 1941. Higher prices brought an increase of 30 percent in value—from $9,457,000 to $12,252,000.

Of the road oil sold in the United States to domestic consumers in 1941, only 365,908 barrels valued at $647,546 were made from foreign petroleum, imported chiefly from Venezuela and Mexico. Of the road oil made from foreign crude oil, nearly all was sold by refineries of the East Coast district.

Road oil sold by petroleum refineries to domestic consumers in the United States, 1940–41, by districts

District	1940		1941	
	Thousands of barrels	Thousands of dollars	Thousands of barrels	Thousands of dollars
East Coast	846	1,464	391	1,542
Appalachian	159	178	44	77
Indiana, Illinois, Kentucky, etc	2,219	2,620	2,603	3,683
Oklahoma, Kansas, and Missouri	878	892	682	1,101
Texas	222	434	237	368
Louisiana-Arkansas	130	149	121	127
Rocky Mountain	1,259	1,433	1,458	1,851
California	2,731	2,287	3,295	3,503
Total United States	8,444	9,457	8,831	12,252

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of road oil in the United States in 1941, by districts, in thousands of barrels

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, losses, and exports	Sales to domestic consumers
			Dec. 31, 1940	Dec. 31, 1941		
East Coast	366	66	44	39	46	391
Appalachian	42	2	1	1		44
Indiana, Illinois, Kentucky, etc	2,477	236	114	168	56	2,603
Oklahoma, Kansas, and Missouri	697	19	34	32	36	682
Texas	173	70	37	35	8	237
Louisiana-Arkansas	141		53	15	58	121
Rocky Mountain	1,651	121	107	252	169	1,458
California	3,602		234	251	290	3,295
Total: 1941	9,149	514	624	793	663	8,831
1940	7,769	937	702	624	840	8,444

CEMENT

By Oliver Bowles and E. V. Balser

SUMMARY OUTLINE

GENERAL CONDITIONS

The portland-cement industry of the United States experienced unusual activity in 1941. Production increased from 130,216,511 barrels (376 pounds each) in 1940 to 164,030,559 barrels in 1941—a 26-percent gain—according to final annual returns submitted by cement companies to the Bureau of Mines. Shipments increased from 130,349,786 barrels valued at $190,078,068 in 1940 to 167,439,237 barrels valued at $246,621,914 in 1941—a gain of 28 percent in quantity and 30 percent in value. The preliminary figures on production for 1941 (published by the Bureau of Mines in January 1942) were 0.02 percent less and shipments 0.04 percent more than the final figures.

The Federal Reserve Board annual index (1935–39=100) for cement production was 154 in 1941 compared with 122 in 1940; for the durable-goods industries it was 193 in 1941 and 135 in 1940. Indexes for total new construction were, respectively, 208 and 137.

In 1941, 155 plants manufactured and shipped portland cement compared with 152 plants in 1940.

The average factory value was $1.47 a barrel in 1941 compared with $1.46 in 1940.

Shipments included 6,123,224 barrels of high-early-strength portland cement valued at $11,443,792 (an average of $1.87 a barrel) in 1941 compared with 4,401,449 barrels (revised figure) valued at $8,243,315 (revised figure) (an average of $1.87 a barrel) in 1940.

The quantity of natural, masonry (natural), and puzzolan cements produced increased 13 percent and shipments 16 percent compared with 1940. The value of shipments of these varieties gained 17 percent.

The preceding figures cover briefly the condition of the cement industry in 1941, and the following tables present its outstanding features during recent years.

Salient statistics of the cement industry in the United States, 1938–41

	1938	1939 [1]	1940 [1]	1941 [1]
Domestic production:				
Portland .... barrels..	105,357,000	122,259,154	130,216,511	164,030,559
Masonry, natural, and puzzolan (slag-lime) barrels..	1,820,795	2,439,110	2,534,566	2,875,962
Total production .... do....	107,177,795	124,698,264	132,751,077	166,906,521
Active plants:				
Portland	151	150	152	155
Masonry, natural, and puzzolan (slag-lime).	12	12	12	12
Domestic shipments:				
Portland .... barrels..	106,324,127	122,651,459	130,349,786	167,439,237
Value	$153,977,226	$180,893,208	$190,078,068	$246,621,914
Masonry, natural, and puzzolan (slag-lime) barrels..	1,867,949	2,405,135	2,514,597	2,926,203
Value	$2,725,776	$3,361,724	$3,386,801	$3,967,567
Total shipments .... barrels..	108,192,076	125,056,594	132,864,383	170,365,440
Value	$156,703,002	$184,254,932	$193,464,869	$250,589,481
Imports .... barrels..	1,727,411	1,913,853	538,060	[2] 43,110
Exports .... do....	558,226	1,146,339	1,667,595	[2] 1,757,172
Apparent consumption .... do....	109,361,261	125,824,108	131,734,848	[3] 168,651,378
Stocks at mills at end of year:				
Portland:				
Finished cement .... do....	23,992,939	23,645,583	[4] 23,364,657	19,955,979
Clinker .... do....	5,286,000	5,165,000	4,886,000	4,575,000
Masonry, natural, and puzzolan (slag-lime) barrels..	373,816	239,938	[4] 259,868	209,627

[1] Includes Puerto Rico (1939 was first year in production).
[2] Figures cover January to September, inclusive.
[3] Includes imports and exports for the first 9 months only.
[4] Revised figures.

Principal hydraulic cements produced and shipped in the United States, 1937–41

Year	Active plants	Production: Portland cement (barrels)	Masonry, natural, and puzzolan (slag-lime) cements: Active plants	Masonry, natural, and puzzolan (slag-lime) cements: Barrels	Total: Active plants	Total: Barrels
1937	150	116,174,708	12	1,900,643	162	118,075,351
1938	151	105,357,000	12	1,820,795	163	107,177,795
1939	[1] 150	[1] 122,259,154	12	2,439,110	[1] 162	[1] 124,698,264
1940	[1] 152	[1] 130,216,511	12	2,534,566	[1] 164	[1] 132,751,077
1941	[1] 155	[1] 164,030,559	12	2,875,962	[1] 167	[1] 166,906,521

Year	Shipments: Portland cement: Barrels	Portland cement: Value	Masonry, natural, and puzzolan (slag-lime) cements: Barrels	Masonry, natural, and puzzolan (slag-lime) cements: Value	Total: Barrels	Total: Value
1937	113,804,782	$168,835,208	1,873,400	$2,578,885	115,678,182	$171,414,093
1938	106,324,127	153,977,226	1,867,949	2,725,776	108,192,076	156,703,002
1939	[1] 122,651,459	[1] 180,893,208	2,405,135	3,361,724	[1] 125,056,594	[1] 184,254,932
1940	[1] 130,349,786	[1] 190,078,068	2,514,597	3,386,801	[1] 132,864,383	[1] 193,464,869
1941	[1] 167,439,237	[1] 246,621,914	2,926,203	3,967,567	[1] 170,365,440	[1] 250,589,481

[1] Includes Puerto Rico (1939 was first year in production).

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

Portland cement occupies a dominant position in modern civilization. Although invented only 118 years ago, it is now regarded as indispensable in highways, sidewalks, bridges, and dams; in the construction of virtually all large buildings; and in airport runways, dry docks, harbors, and a multitude of other major and minor projects. Both farmers and city dwellers use it in innumerable ways.

Cement is immeasurably important in facilitating the far-reaching program of military expansion that is steadily climbing toward a

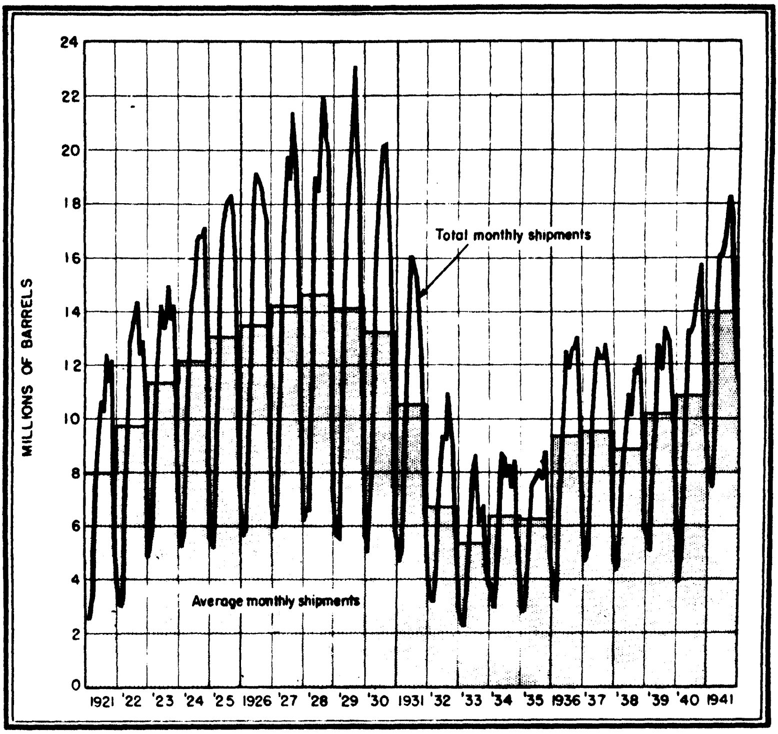

FIGURE 1.—Total monthly and average monthly shipments of portland cement in the United States, 1921-41.

climax. Many military projects require enormous quantities of cement, and even the hastily built temporary types of war construction ordinarily must have cement foundations if safety and stability are to be assured. The increase in shipments, amounting to 28 percent in 1941 compared with 1940, was due largely to the growing requirements of military establishments under construction in numerous localities throughout the United States.

Cement shipments fluctuate greatly, according to the season. Figure 1 shows the volume of portland cement shipped each month compared with the average monthly shipments for each year. The chart shows that the fluctuations are lessening gradually, a condition due partly to improved adaptability of cements to cold-weather use

and partly to a growing movement toward winter construction. Because of the strong demands for military uses, the recession in shipments during the latter months of 1941 was less pronounced than in the pattern of previous years.

Common, general-purpose portland cement is the principal product, but large quantities of special types are also marketed. They have been developed during recent years to satisfy new conditions that have arisen in construction. Thus high-early-strength cement is used where time-saving is important, low- or moderate-heat-of-hydration cements have become a necessity in the construction of monolithic dams, and special oil-well cements have made it possible to solve difficult problems in the petroleum industry. Statistics for all varieties are given in the general portland-cement tables, and the special varieties are discussed in more detail, with statistics wherever available, in a later section of this report. The special portland cements are to be distinguished from certain other types, such as natural and slag-lime cements, which are not true portland cements and are covered in a separate section of this chapter.

The principal statistics of portland cement appear in the following tables. In the first, which relates to production, shipments, and stocks by States and districts, the term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places, its mill or group of mills at each place is counted as one plant. The districts are groups of States related geographically and commercially.

The tables giving data by months, compiled from monthly reports of the producers, include figures on clinker or unground cement produced and in reserve at the mills awaiting manufacture into finished cement. Although the figures may differ slightly from those based upon annual reports of the producers, they accurately reflect seasonal fluctuations in the industry.

Portland cement produced, shipped, and in stock in the United States, 1940–41, by States and districts

State and district	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease in 1941 (percent)	1940		1941		Average factory value per barrel		Increase or decrease in quantity in 1941 (percent)	Barrels		Increase or decrease in 1941 (percent)
	1940	1941	1940	1941		Barrels	Value	Barrels	Value	1940	1941		1940	1941 [1]	
STATE															
Alabama	6	6	5, 122, 307	7, 410, 499	+45	5, 249, 759	$7, 617, 405	7, 610, 030	$11, 142, 649	$1. 45	$1 46	+45	[2] 543, 548	344, 017	−37
California	11	12	14, 215, 745	19, 935, 309	+40	13, 813, 362	17, 296, 522	20, 186, 028	28, 019, 494	1 25	1 39	+46	[2] 1, 623, 669	1, 372, 950	−15
Illinois	4	4	4, 974, 917	5, 854, 218	+18	4, 937, 127	7, 209, 431	5, 958, 376	8, 660, 104	1 46	1. 45	+21	718, 349	614, 191	−14
Iowa	5	5	4, 605, 886	5, 064, 620	+10	4, 597, 781	7, 641, 163	5, 328, 398	8, 659, 014	1. 66	1. 63	+16	[2] 1, 550, 802	1, 287, 024	−17
Kansas	6	6	3, 433, 033	4, 680, 636	+36	3, 441, 612	5, 192, 160	4, 734, 129	7, 136, 933	1. 51	1 51	+38	[2] 1, 067, 783	1, 014, 290	−5
Michigan	9	11	8, 603, 188	9, 485, 147	+10	8, 519, 416	11, 389, 191	9, 819, 218	13, 333, 850	1 34	1 36	+15	[2] 2, 032, 527	1, 698, 456	−16
Missouri	5	5	4, 968, 106	6, 328, 003	+27	4, 867, 799	7, 616, 247	6, 516, 345	10, 272, 509	1. 56	1. 58	+34	[2] 1, 152, 235	963, 893	−16
New York	11	11	8, 437, 368	11, 444, 508	+36	8, 251, 038	11, 687, 089	11, 446, 292	16, 073, 726	1 42	1 40	+39	[2] 1, 798, 318	1, 796, 534	−. 1
Ohio	9	9	6, 664, 115	8, 155, 704	+22	6, 841, 129	9, 202, 414	8, 021, 857	10, 657, 677	1 35	1 33	+17	[2] 1, 111, 028	1, 244, 875	+12
Pennsylvania	25	25	26, 853, 002	32, 199, 184	+20	27, 499, 786	38, 350, 998	32, 868, 220	45, 383, 766	1. 39	1. 38	+20	[2] 5, 000, 685	4, 331, 649	−13
Puerto Rico	1	1	385, 824	462, 628	+20	384, 242	629, 876	465, 158	1, 005, 472	1 64	2 16	+21	2, 832	302	−89
Tennessee	6	6	3, 808, 307	5, 588, 488	+47	3, 766, 807	5, 655, 635	5, 623, 800	8, 520, 284	1 50	1 52	+49	[2] 434, 977	399, 665	−8
Texas	10	10	7, 374, 886	9, 679, 696	+31	7, 383, 600	12, 198, 800	9, 842, 260	16, 362, 293	1. 65	1. 66	+33	[2] 901, 910	739, 346	−18
Other States [3]	44	44	30, 769, 827	37, 741, 919	+23	30, 796, 328	48, 391, 137	39, 019, 126	61, 394, 143	1 57	1 57	+27	[2] 5, 425, 994	4, 148, 787	−24
	152	155	130, 216, 511	164, 030, 559	+26	130, 349, 786	190, 078, 068	167, 439, 237	246, 621, 914	1. 46	1. 47	+28	[2] 23, 364, 657	19, 955, 979	−15
DISTRICT															
Eastern Pennsylvania, New Jersey, and Maryland	22	22	24, 970, 132	31, 017, 939	+24	25, 497, 435	35, 525, 165	31, 482, 250	43, 493, 559	1 39	1. 38	+23	[2] 4, 175, 002	3, 710, 691	−11
New York and Maine	12	12	8, 784, 509	11, 995, 299	+37	8, 613, 535	12, 305, 493	12, 049, 832	17, 099, 278	1. 43	1. 42	+40	[2] 1, 922, 757	1, 868, 224	−3
Ohio, western Pennsylvania, and West Virginia	18	18	13, 374, 846	15, 153, 118	+13	13, 641, 016	18, 425, 279	15, 340, 784	20, 509, 369	1. 35	1. 34	+12	[2] 2, 619, 082	2, 431, 416	−7
Michigan	9	11	8, 603, 188	9, 485, 147	+10	8, 519, 416	11, 389, 191	9, 819, 218	13, 333, 850	1. 34	1. 36	+15	[2] 2, 032, 527	1, 698, 456	−16
Wisconsin, Illinois, Indiana, and Kentucky	11	11	12, 663, 788	16, 224, 049	+28	12, 735, 763	19, 158, 407	16, 750, 575	24, 981, 549	1. 50	1. 49	+32	[2] 2, 128, 641	1, 602, 115	−25

[1] Subject to revision.
[2] Revised figures.
[3] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Portland cement produced, shipped, and in stock in the United States, 1940–41, by States and districts—Continued

State and district	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease in 1941 (percent)	1940		1941		Average factory value per barrel		Increase or decrease in quantity in 1941 (percent)	Barrels		Increase or decrease in 1941 (percent)
	1940	1941	1940	1941		Barrels	Value	Barrels	Value	1940	1941		1940	1941	
DISTRICT—continued															
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	18	18	14,710,971	19,982,460	+36	14,852,453	$22,473,321	20,391,422	$30,983,258	$1.51	$1.52	+37	[1] 1,513,855	1,104,893	−27
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	10,304,229	11,856,659	+15	10,170,536	16,540,187	12,443,248	19,990,722	1.63	1.61	+22	[1] 3,013,899	2,427,310	−19
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	7,597,759	9,903,055	+30	7,614,858	11,527,579	10,179,426	15,372,190	1.51	1.51	+34	[1] 2,115,608	1,839,237	−13
Texas	10	10	7,374,886	9,679,696	+31	7,383,600	12,198,800	9,842,260	16,362,293	1.65	1.66	+33	[1] 901,910	739,346	−18
Colorado, Montana, Utah, Wyoming, and Idaho	8	8	2,961,823	3,954,582	+34	2,951,094	5,420,245	4,024,563	7,317,339	1.84	1.82	+36	[1] 609,980	539,999	−11
California	11	12	14,215,745	19,935,309	+40	13,813,362	17,296,522	20,186,028	28,019,494	1.25	1.39	+46	[1] 1,623,669	1,372,950	−15
Oregon and Washington	9	9	4,268,811	4,380,618	+3	4,172,476	7,188,003	4,464,473	8,153,541	1.72	1.83	+7	[1] 704,895	621,040	−12
Puerto Rico	1	1	385,824	462,628	+20	384,242	629,876	465,158	1,005,472	1.64	2.16	+21	2,832	302	−89
	152	155	130,216,511	164,030,559	+26	130,349,786	190,078,068	167,439,237	246,621,914	1.46	1.47	+28	[1] 23,364,657	19,955,979	−15

[1] Revised figures.

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1941, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	1,555	1,612	2,335	2,482	2,836	2,937	3,045	3,000	2,816	2,992	2,829	2,603
New York and Maine	631	486	663	869	1,142	1,176	1,241	1,274	1,238	1,209	1,183	876
Ohio, western Pennsylvania, and West Virginia	601	717	973	1,178	1,409	1,467	1,518	1,594	1,425	1,617	1,362	1,368
Michigan	533	357	359	628	941	1,082	970	841	1,065	1,069	942	699
Wisconsin, Illinois, Indiana, and Kentucky	1,152	925	1,058	1,281	1,355	1,320	1,484	1,713	1,599	1,690	1,327	1,319
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,496	1,421	1,448	1,544	1,674	1,684	1,746	1,769	1,764	1,870	1,765	1,791
Eastern Missouri, Iowa, Minnesota, and South Dakota	426	376	529	644	1,006	1,169	1,348	1,283	1,357	1,365	1,234	1,096
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	464	358	482	762	1,039	1,036	1,007	969	1,085	981	866	854
Texas	654	637	742	798	832	806	837	976	930	859	779	829
Colorado, Montana, Utah, Wyoming, and Idaho	121	127	282	250	367	411	420	431	394	465	375	311
California	1,266	1,098	1,400	1,389	1,695	1,659	1,844	1,934	1,869	2,074	1,898	1,728
Oregon and Washington	88	201	294	347	419	430	494	517	528	447	325	288
Puerto Rico	34	30	31	24	17	46	46	44	45	50	46	48
United States: 1941	9,021	8,345	10,596	12,196	14,732	15,223	16,000	16,345	16,115	16,688	14,931	13,810
1940	6,205	5,041	7,918	10,043	12,633	12,490	12,290	12,712	13,105	13,935	12,725	11,195
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	1,389	1,458	1,830	2,969	3,188	3,127	3,078	3,093	3,216	3,313	2,623	2,198
New York and Maine	526	471	562	1,057	1,155	1,264	1,176	1,293	1,388	1,403	1,015	763
Ohio, western Pennsylvania, and West Virginia	534	522	823	1,351	1,535	1,512	1,671	1,734	1,795	1,744	1,279	936
Michigan	340	295	390	778	953	1,067	1,058	1,144	1,221	1,203	802	568
Wisconsin, Illinois, Indiana, and Kentucky	612	600	923	1,340	1,657	1,697	1,905	2,045	1,958	1,828	1,275	915
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,442	1,254	1,460	1,830	1,828	1,635	1,725	1,861	1,980	2,051	1,736	1,589
Eastern Missouri, Iowa, Minnesota, and South Dakota	325	303	489	893	1,234	1,260	1,411	1,641	1,753	1,528	917	691
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	435	441	674	837	995	922	931	1,060	1,119	924	901	941
Texas	793	628	707	779	895	791	914	975	885	782	850	844
Colorado, Montana, Utah, Wyoming, and Idaho	123	153	227	313	393	472	473	493	493	445	271	170
California	1,243	1,119	1,540	1,656	1,777	1,846	1,824	1,831	1,904	2,075	1,716	1,590
Oregon and Washington	190	193	256	305	408	470	474	610	532	483	295	256
Puerto Rico	32	19	34	24	30	46	47	45	40	54	44	50
United States 1941	7,984	7,456	9,915	14,132	16,048	16,109	16,687	17,825	18,284	17,833	13,724	11,511
1940	3,893	4,907	7,716	10,829	13,206	13,223	13,442	14,018	14,741	15,776	10,372	8,192

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1941, by districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	4,331	4,486	4,991	4,506	4,154	3,963	3,929	3,836	3,434	3,113	3,319	3,723
New York and Maine	2,038	2,053	2,153	1,960	1,948	1,862	1,927	1,909	1,760	1,566	1,735	1,847
Ohio, western Pennsylvania, and West Virginia	2,708	2,903	3,053	2,880	2,754	2,708	2,556	2,424	2,054	1,926	2,008	2,432
Michigan	2,226	2,288	2,256	2,107	2,094	2,109	2,021	1,718	1,561	1,427	1,568	1,699
Wisconsin, Illinois, Indiana, and Kentucky	2,668	2,993	3,128	3,069	2,776	2,399	1,979	1,646	1,288	1,150	1,198	1,602
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,568	1,735	1,724	1,444	1,291	1,342	1,362	1,270	1,054	874	902	1,104
Eastern Missouri, Iowa, Minnesota, and South Dakota	3,121	3,194	3,234	2,986	2,757	2,666	2,604	2,245	1,850	1,687	2,004	2,410
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2,145	2,062	1,870	1,796	1,840	1,954	2,029	1,938	1,905	1,961	1,926	1,839
Texas	764	773	808	827	764	779	702	704	748	825	754	740
Colorado, Montana, Utah, Wyoming, and Idaho	611	584	639	576	550	489	435	373	274	294	399	536
California	1,633	1,612	1,473	1,205	1,119	936	956	1,083	1,047	1,047	1,234	1,372
Oregon and Washington	598	608	646	687	698	658	678	586	582	547	589	621
Puerto Rico	5	16	13	13					4		2	
United States 1941	24,416	25,307	25,988	24,056	22,745	21,865	21,178	19,732	17,561	16,417	17,638	19,925
1940	25,759	25,894	26,118	25,348	24,758	24,010	22,855	21,549	19,921	18,008	20,353	23,379

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1941, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	1,620	1,654	2,346	2,418	2,758	2,960	2,968	2,919	2,762	2,969	2,746	2,650
New York and Maine	604	551	640	867	1,112	1,055	1,224	1,286	1,201	1,138	1,121	931
Ohio, western Pennsylvania, and West Virginia	609	789	1,179	1,201	1,421	1,459	1,502	1,563	1,456	1,429	1,355	1,295
Michigan	651	411	554	580	917	982	976	964	944	979	891	757
Wisconsin, Illinois, Indiana, and Kentucky	1,183	1,036	1,145	1,225	1,343	1,433	1,527	1,593	1,493	1,589	1,420	1,408
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,453	1,392	1,526	1,523	1,650	1,640	1,772	1,714	1,755	1,865	1,761	1,815
Eastern Missouri, Iowa, Minnesota, and South Dakota	534	413	521	664	1,016	1,190	1,277	1,325	1,247	1,343	1,164	1,116
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	390	387	530	808	1,038	977	1,015	964	1,091	948	845	809
Texas	613	675	798	792	788	730	809	939	941	855	801	900
Colorado, Montana, Utah, Wyoming, and Idaho	155	113	226	291	384	378	374	407	342	464	389	341
California	1,363	1,163	1,440	1,352	1,617	1,702	1,784	1,863	1,960	1,942	1,948	1,903
Oregon and Washington	60	159	388	387	462	410	451	501	444	461	443	225
Puerto Rico	34	30	32	21	18	48	60	48	32	36	51	47
United States: 1941	9,269	8,773	11,325	12,129	14,524	14,964	15,739	16,086	15,668	16,018	14,935	14,197
1940	6,720	5,776	8,127	10,199	12,154	12,303	11,916	12,283	12,799	13,569	12,779	11,517
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	696	747	766	719	655	699	639	584	556	545	478	532
New York and Maine	324	391	371	381	363	255	252	281	255	229	193	258
Ohio, western Pennsylvania, and West Virginia	496	581	795	812	836	836	823	810	849	680	700	594
Michigan	506	557	742	685	645	552	546	660	525	431	374	440
Wisconsin, Illinois, Indiana, and Kentucky	349	455	543	481	449	536	561	433	319	203	281	361
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	326	306	390	406	383	339	357	304	291	286	285	304
Eastern Missouri, Iowa, Minnesota, and South Dakota	349	385	384	406	430	449	392	450	354	329	266	273
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	267	297	346	387	389	332	345	327	337	301	282	236
Texas	213	233	295	264	226	156	136	109	129	134	171	249
Colorado, Montana, Utah, Wyoming, and Idaho	260	247	192	233	252	220	176	153	103	103	118	149
California	984	1,042	1,075	1,016	914	934	870	691	762	622	647	795
Oregon and Washington	311	268	364	406	451	434	395	381	299	317	436	364
Puerto Rico	11	11	13	11	12	15	30	36	25	12	19	20
United States: 1941	5,092	5,520	6,276	6,207	6,005	5,757	5,522	5,219	4,804	4,192	4,250	4,575
1940	5,617	6,304	6,487	6,606	6,071	5,907	5,559	5,158	4,829	4,470	4,568	4,896

Producers' stocks of portland cement on hand at the mills were 15 percent lower at the end of 1941 than at the end of 1940. The following table gives stocks on December 31 and the seasonal fluctuations in stocks from 1937 to 1941.

Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1937–41

		Dec. 31 (barrels)	Monthly range			
			Low		High	
			Month	Barrels	Month	Barrels
1937	Cement	24,913,245	September	21,388,000	April	25,747,000
	Clinker	6,342,000	October	5,859,000	March	7,554,000
1938	Cement	23,992,939	do	20,569,000	January	25,023,000
	Clinker	5,286,000	do	4,927,000	February	6,782,000
1939	Cement	[1] 23,645,583	do	19,870,000	do	24,092,000
	Clinker	5,165,000	November	4,824,000	April	6,568,000
1940 [1]	Cement	[2] 23,364,657	October	18,008,000	March	26,118,000
	Clinker	4,886,000	do	4,470,000	April	6,606,000
1941 [1]	Cement	19,955,979	October	16,417,000	March	25,988,000
	Clinker	4,575,000	do	4,192,000	do	6,276,000

[1] Includes Puerto Rico (1939 was first year in production).
[2] Revised figure.

DOMESTIC CONSUMPTION

Apparent consumption (shipments plus imports minus exports) for the entire United States for a series of years is indicated in the salient statistics presented as the first table in this chapter. The only available gage of consumption by States is the record of shipments into States by manufacturers; it is therefore merely approximate. Cement shipped to destinations within a State in which it is manufactured is, of course, added to that shipped from other States. Shipments into a State during any year may not equal the consumption during that year but over a series of years should afford a fair index of consumption. The following table shows shipments into States in 1940 and 1941 and per capita consumption in each State.

Shipments of domestic portland cement from mills into States and per capita, 1940–41, in barrels

State	1940		1941	
	Total	Per capita [1]	Total	Per capita [1]
Alabama	1,458,811	0.51	2,491,851	0.88
Arizona [2]	558,629	1.12	793,838	1.59
Arkansas	812,931	.42	1,146,712	.59
California	11,619,397	1.68	16,850,718	2.44
Colorado	1,028,753	.92	1,520,646	1.35
Connecticut [2]	1,893,733	1.11	2,379,471	1.39
Delaware [2]	416,056	1.56	394,451	1.48
District of Columbia [2]	1,605,768	2.42	1,590,499	2.40
Florida	2,442,623	1.29	3,172,179	1.67
Georgia	1,901,663	.61	2,671,255	.86
Idaho	334,360	.64	448,380	.85
Illinois	8,584,009	1.09	9,165,894	1.16
Indiana	3,628,891	1.06	5,319,791	1.55
Iowa	2,933,570	1.16	3,259,370	1.28
Kansas	1,627,535	.90	2,061,704	1.14

[1] Per capita figures based upon latest available estimates of population made by Bureau of the Census.
[2] Non-cement-producing State.

Shipments of domestic portland cement from mills into States and per capita, 1940–41, in barrels—Continued

State	1940		1941	
	Total	Per capita	Total	Per capita
Kentucky	2,006,097	0.70	2,705,374	0.95
Louisiana	2,168,927	.92	2,837,225	1.20
Maine	331,685	.39	623,245	.74
Maryland	2,141,788	1.18	3,093,522	1.70
Massachusetts [2]	2,707,242	.63	3,029,370	.70
Michigan	5,760,481	1.10	6,907,824	1.31
Minnesota	2,562,578	.92	3,035,480	1.09
Mississippi [2]	1,330,367	.61	1,407,063	.64
Missouri	3,150,489	.83	5,029,976	1.33
Montana	419,796	.75	457,899	.82
Nebraska	1,122,140	.85	1,380,339	1.05
Nevada [2]	172,710	1.57	250,236	2.27
New Hampshire [2]	428,752	.87	518,691	1.06
New Jersey	4,165,289	1.00	5,353,149	1.29
New Mexico [2]	514,490	.97	749,023	1.41
New York	13,119,568	.97	14,096,501	1.05
North Carolina [2]	1,770,738	.50	2,574,455	.72
North Dakota [2]	290,711	.45	361,416	.56
Ohio	6,538,166	.95	8,455,877	1.22
Oklahoma	1,886,668	.81	2,131,784	.91
Oregon	906,358	.83	1,529,971	1.40
Pennsylvania	10,008,425	1.01	10,000,181	1.01
Rhode Island [2]	649,373	.91	834,261	1.17
South Carolina [2]	1,118,340	.59	1,759,468	.93
South Dakota	427,254	.66	432,431	.67
Tennessee	2,455,317	.84	4,281,918	1.47
Texas	6,478,976	1.01	8,598,148	1.34
Utah	679,370	1.23	1,196,451	2.17
Vermont [2]	246,820	.69	238,436	.66
Virginia	2,381,902	.89	4,771,954	1.78
Washington	3,540,956	2.04	3,015,298	1.74
West Virginia	1,318,364	.69	1,690,142	.89
Wisconsin	2,604,168	.83	3,187,293	1.02
Wyoming	250,901	1.00	284,771	1.14
	126,501,935	.96	160,085,931	1.22
Unspecified [3]	3,847,851		7,353,306	
Total shipped from cement plants	130,349,786		167,439,237	

[2] Non-cement-producing State.
[3] Includes shipments to Alaska, Hawaii, Puerto Rico, and foreign countries.

The per capita consumption indicated in the foregoing table falls short of the total apparent consumption by the quantity of imports, which affects to a limited extent certain States near the Canadian border and the seaboard.

The accompanying table of monthly shipments from portland-cement mills into States in 1941 is based upon monthly reports of producers. Although the totals may vary slightly from figures shown in tables based upon annual reports, they show seasonal fluctuations with fair accuracy.

Portland cement shipped from mills into States in 1941, by months, in barrels

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	132,073	122,487	137,883	161,922	189,899	212,447	198,274	246,147	258,479	278,201	245,539	304,018
Arizona	39,629	46,483	52,787	50,828	72,599	82,299	61,381	44,502	70,229	99,510	85,809	74,635
Arkansas	75,740	58,870	78,916	65,051	76,305	88,902	82,904	81,599	76,419	114,218	187,146	162,232
California	1,001,303	918,273	1,298,477	1,364,680	1,422,474	1,589,958	1,538,762	1,620,342	1,654,580	1,662,225	1,421,885	1,329,878
Colorado	42,068	52,311	67,741	109,831	156,912	179,732	193,533	180,789	178,759	178,724	109,658	70,140
Connecticut	77,324	79,145	105,923	195,493	257,149	271,337	263,027	273,009	281,712	252,494	190,800	132,678
Delaware	15,170	13,865	22,414	41,562	37,888	35,077	46,916	35,037	46,597	45,150	32,077	23,381
District of Columbia	83,714	79,633	94,686	166,220	147,256	130,542	141,025	164,674	158,936	156,284	141,163	124,829
Florida	257,024	234,896	215,466	230,987	229,581	218,922	251,777	274,295	302,685	350,971	325,530	279,310
Georgia	183,489	145,207	152,602	172,667	228,892	235,670	270,480	250,084	249,452	290,827	277,704	213,520
Idaho	14,463	21,976	31,686	38,691	43,435	46,099	47,580	56,897	73,071	34,475	25,564	14,446
Illinois	352,548	327,946	491,089	776,920	943,024	942,802	1,102,216	1,093,880	1,047,011	891,095	706,069	510,108
Indiana	162,013	171,486	316,909	474,543	570,316	598,393	688,713	732,425	589,159	457,585	320,147	226,229
Iowa	38,086	44,732	113,032	275,598	383,048	344,311	355,567	480,806	506,715	401,547	183,424	131,209
Kansas	80,013	92,438	161,608	213,180	219,694	198,041	185,357	173,928	202,188	163,003	172,945	188,561
Kentucky	103,087	119,352	156,473	171,613	200,004	225,542	248,092	321,899	396,247	374,093	240,798	157,551
Louisiana	297,456	186,496	217,132	258,250	240,409	201,132	219,550	240,237	231,402	269,788	247,564	227,053
Maine	5,867	9,229	16,984	38,356	61,830	61,020	57,172	80,671	116,667	116,583	36,505	22,384
Maryland	143,208	158,654	201,339	323,101	333,897	269,808	299,131	307,018	314,301	311,407	257,070	191,025
Massachusetts	124,748	111,247	132,291	266,133	308,591	346,248	314,939	333,835	357,120	335,047	244,933	170,894
Michigan	250,758	229,949	273,088	542,441	623,424	721,620	734,307	781,449	844,056	881,480	572,095	438,621
Minnesota	53,191	44,105	85,231	223,254	329,539	328,053	338,008	405,994	505,434	442,324	189,181	90,289
Mississippi	92,898	57,190	79,573	102,676	105,273	112,496	104,073	114,455	156,012	217,862	127,693	137,263
Missouri	158,298	201,077	312,213	366,822	480,970	477,607	553,837	606,398	571,263	473,929	415,265	410,999
Montana	17,803	17,339	35,654	47,757	50,697	66,230	54,366	38,430	49,422	42,562	24,246	13,293
Nebraska	27,121	29,035	57,332	104,471	162,240	144,799	138,514	230,273	181,418	159,808	90,681	54,212
Nevada	8,520	8,277	26,402	16,496	20,608	17,807	17,409	14,528	14,586	22,119	42,618	36,341
New Hampshire	16,085	15,219	27,324	53,001	47,049	54,741	63,112	67,069	60,535	50,554	34,336	30,082
New Jersey	235,719	221,115	271,030	498,113	535,103	538,464	517,447	541,471	568,474	568,696	442,733	419,471
New Mexico	32,199	38,038	46,889	61,000	78,989	87,176	105,768	105,378	73,220	42,078	46,531	31,367
New York	695,974	642,436	785,344	1,322,395	1,472,804	1,438,122	1,408,891	1,452,220	1,478,907	1,531,382	1,079,715	799,478
North Carolina	164,466	145,553	182,756	234,893	284,382	215,033	206,412	203,482	255,275	271,254	229,660	170,561
North Dakota	3,877	4,053	8,894	29,173	44,873	51,491	71,111	52,894	39,238	37,282	11,859	6,573
Ohio	306,440	312,028	478,082	762,439	881,841	890,731	888,329	922,820	959,731	905,004	653,598	495,532
Oklahoma	110,559	102,816	168,733	189,895	202,604	187,736	180,520	177,152	237,189	137,803	193,641	242,782
Oregon	57,298	64,503	79,779	102,101	143,988	154,207	155,629	194,771	226,276	209,524	75,955	61,110
Pennsylvania	317,385	293,406	507,993	896,429	987,105	963,015	1,110,733	1,159,418	1,263,937	1,130,768	829,359	593,406
Rhode Island	48,467	45,512	58,891	98,933	113,640	111,962	72,174	68,958	65,026	62,132	49,439	38,540
South Carolina	121,058	107,245	118,760	129,623	152,070	154,547	152,782	160,893	191,662	195,978	161,185	119,530
South Dakota	12,195	9,522	18,029	37,612	53,290	55,154	51,141	49,023	130,994	43,757	22,514	13,888
Tennessee	240,590	215,173	280,285	351,449	355,532	322,893	344,055	387,369	374,249	526,174	434,652	385,529
Texas	707,333	578,311	634,777	672,989	779,402	613,637	760,888	838,810	805,181	698,206	718,351	788,065
Utah	27,365	34,626	63,248	77,147	95,482	123,070	119,932	177,302	184,693	163,604	83,478	48,289
Vermont	4,366	5,089	5,396	22,499	28,859	25,761	27,202	31,057	36,577	26,474	19,030	7,283

Virginia	292,108	261,485	326,523	475,113	528,713	385,524	409,564	396,554	421,428	456,891	425,188	397,889
Washington	149,228	151,306	198,392	226,394	304,749	347,737	338,457	410,353	312,492	301,699	222,906	194,238
West Virginia	68,870	64,448	99,031	175,689	179,702	165,914	175,061	177,302	176,026	179,110	131,042	100,676
Wisconsin	73,728	67,736	109,439	235,974	309,972	361,376	357,448	444,352	426,484	444,955	222,185	129,127
Wyoming	20,409	16,707	15,684	24,790	29,645	29,224	31,647	31,973	32,062	25,769	16,257	14,204
	7,543,331	6,978,025	9,420,210	13,477,194	15,505,748	15,424,409	16,055,213	17,237,222	17,753,576	17,032,405	13,017,723	10,822,719
Unspecified	440,669	477,975	494,790	654,806	542,252	684,591	631,787	587,778	530,424	800,595	706,277	688,281
Total shipped from cement plants	7,984,000	7,456,000	9,915,000	14,132,000	16,048,000	16,109,000	16,687,000	17,825,000	18,284,000	17,833,000	13,724,000	11,511,000

[1] Includes shipments to Alaska, Hawaii, Puerto Rico, and foreign countries

LOCAL SUPPLIES

The following table compares the shipments from mills within a State or group of States with the estimated consumption (State receipts of mill shipments) and indicates the surplus or deficiency in the supply of cement locally available. Consumption in the States that do not produce cement is indicated in a preceding table showing shipments into each State.

The surplus cement shown in this table was distributed as follows: In 1940—to non-cement-producing States 13,703,729 barrels and to foreign countries, Alaska, Hawaii, and unspecified destinations 2,863,034 barrels; in 1941—to non-cement-producing States 16,880,678 barrels and to foreign countries, Alaska, Hawaii, and unspecified destinations 5,919,919 barrels.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1940–41, in barrels

State or division	1940			1941		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	5,249,759	1,458,811	+3,790,948	7,610,030	2,491,851	+5,118,179
California	13,813,362	11,619,397	+2,193,965	20,186,028	16,850,718	+3,335,310
Illinois	4,937,127	8,584,009	−3,646,882	5,958,376	9,165,894	−3,207,518
Iowa	4,597,781	2,933,570	+1,664,211	5,328,398	3,259,370	+2,069,028
Kansas	3,441,612	1,627,535	+1,814,077	4,734,129	2,061,704	+2,672,425
Michigan	8,519,416	5,760,481	+2,758,935	9,819,218	6,907,824	+2,911,394
Missouri	4,867,799	3,150,489	+1,717,310	6,516,345	5,029,976	+1,486,369
Ohio	6,841,129	6,538,166	+302,963	8,021,857	8,455,877	−434,020
Pennsylvania	27,499,786	10,008,425	+17,491,361	32,868,220	10,000,181	+22,868,039
Puerto Rico	384,242	984,817	−600,575	465,158	1,433,387	−968,229
Tennessee	3,766,807	2,455,317	+1,311,490	5,623,800	4,281,918	+1,341,882
Texas	7,383,600	6,478,976	+904,624	9,842,260	8,598,148	+1,244,112
Colorado, Montana, Utah, Wyoming, and Idaho	2,951,094	2,713,180	+237,914	4,024,563	3,908,147	+116,416
Oregon and Washington	4,172,476	4,447,314	−274,838	4,464,473	4,545,269	−80,796
Georgia, Kentucky, Virginia, Florida, and Louisiana	6,727,762	10,901,212	−4,173,450	8,493,161	16,157,987	−7,664,826
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	11,784,963	13,044,630	−1,259,667	15,500,432	16,633,830	−1,133,398
Maryland, New Jersey, and West Virginia	4,797,536	7,625,441	−2,827,905	5,932,957	10,136,813	−4,203,856
New York and Maine	8,613,535	13,451,253	−4,837,718	12,049,832	14,719,746	−2,669,914
	130,349,786	113,783,023	+16,566,763	167,439,237	144,638,640	+22,800,597

TRANSPORTATION

The following table for 1939, 1940, and 1941, showing quantities of portland cement shipped from mills by truck, railroad, and boat, in bulk and in containers, is given because charges for transportation and delivery are important items in the cost of cement to consumers. Data for mode of shipping were lacking in 1939 for 5,681,405 barrels—about 5 percent of total shipments for the year.

The table presented herein is based upon the quantities of cement actually apportioned by the reporting companies; as it represents a very large proportion of the total quantity shipped, it may be assumed that the percentages thus obtained are approximately correct for the industry as a whole.

The earliest data obtained by the Bureau of Mines, those for 1928, show that 2.4 percent of total cement shipments was shipped in bulk

and 97.6 percent in containers. Shipments in bulk were reported in 1939 by 137 plants, representing 33 States; in 1940 by 144 plants, representing 32 States; and in 1941 by 150 plants, representing 35 States.

Shipments of portland cement from mills in the United States, 1939–41, in bulk and in containers, by types of carriers

[Unit of measure, barrels of 376 pounds]

Type of carrier	In bulk		In containers				Mode of shipping not stated	Total shipments	
			In bags		In other containers [1]	Total in containers			
			Paper	Cloth					
	Barrels	*Percent*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Percent*
1939 [2]									
Truck	[3] 2,078,494	8.6	7,325,535	6,913,700	140,904	14,380,139		16,458,633	13.4
Railroad	21,255,557	87.9	43,327,220	33,360,063	34,220	76,721,503		97,977,060	79.9
Boat	600,446	2.5	1,302,465	631,450		1,933,915		2,534,361	2.1
Not stated	250,594	1.0	439,221	498,273		937,494	4,493,317	5,681,405	4.6
	24,185,091	100.0	52,394,441	41,403,486	175,124	93,973,051	4,493,317	122,651,459	100.0
Percent of total	19.7		42.7	33.8	0.1	76.6	3.7	100.0	
1940 [2]									
Truck	[3] 3,873,113	11.6	[4] 8,325,992	8,095,980		[4] 16,421,972		[4] 20,295,085	15.6
Railroad	[4] 28,870,110	86.5	[4] 45,724,386	[4] 32,522,949	23,527	[4] 78,270,862		[4] 107,140,972	82.2
Boat	614,471	1.9	1,319,683	[4] 971,870		[4] 2,291,553		[4] 2,906,024	2.2
Pipeline	7,705	(5)						7,705	(5)
	33,365,399	100.0	55,370,061	41,590,799	23,527	96,984,387		130,349,786	100.0
Percent of total	25.6		42.5	31.9	(5)	74.4		100.0	
1941 [2]									
Truck	[3] 5,481,732	10.6	9,989,551	9,310,998		19,300,549		24,782,281	14.8
Railroad	44,641,936	86.1	53,863,493	39,506,899	31,141	93,401,533		138,043,469	82.4
Boat	1,559,678	3.0	2,414,842	496,452	150	2,911,444		4,471,122	2.7
Pipeline	142,365	.3						142,365	.1
	51,825,711	100.0	66,267,886	49,314,349	31,291	115,613,526		167,439,237	100.0
Percent of total	31.0		39.6	29.4	(5)	69.0		100.0	

[1] Includes steel drums and iron and wood barrels.
[2] Includes shipments for Puerto Rico.
[3] Includes cement used at mills by producers as follows: 1939, 132,238 barrels; 1940, 118,709 barrels; 1941, 196,765 barrels.
[4] Revised figures.
[5] Less than 0.05 percent.

PRICES

The average selling price of portland cement, f. o. b. factory (excluding the price of containers and cash discounts), as reported to the Bureau of Mines, is stated in the table of shipments by States and districts during 1940 and 1941. The average factory value in some States is higher than the average for ordinary structural cement because considerable quantities of certain special cements that command relatively high prices are included—for example, white portland cement manufactured in California, Pennsylvania, and Texas and high-early-strength portland cement produced in many States. The average selling price per barrel, f. o. b. factory, of white portland cement in 1941 was $3.99; in 1940 it was $3.89. The average price f. o. b. mill of high-early-strength portland cement was $1.87 a barrel in 1940 and 1941. The sales value of other hydraulic cements is given later in this chapter.

The following table shows the average factory value of portland cement from 1937 through 1941.

Average factory value per barrel in bulk of portland cement in the United States, 1937–41

1937	$1.48	1940 [1]	$1.46
1938	1.45	1941 [1]	1.47
1939 [1]	1.47		

[1] Includes Puerto Rico (1939 was first year in production).

LOCATION OF PLANTS

The accompanying map (fig. 2) shows the location of cement plants in the United States. Raw materials for manufacture of portland cement are so plentiful and widely distributed that other factors, such as markets and transportation facilities, are usually the principal elements that control selection of plant location. Most of the plants are contiguous to populous industrial centers. About four-fifths of all the portland-cement plants in the United States are in the Eastern and Middle Western States. Throughout the Great Plains and Rocky Mountain country they are more scattered. Concentrations of plants on the Pacific coast (California and Washington) are due partly to the requirements of growing industrialization areas and partly to the extensive demands of great reclamation projects. Only 12 States and the District of Columbia have no cement plants, and the greatest number in any one State (Pennsylvania) is 26; the Nevada plant was under construction in 1941.

CAPACITY OF PLANTS

At the end of 1941 the capacity of plants producing finished portland cement was 247,359,000 barrels a year, according to manufacturers' reports. This comprised 155 plants active and shipping in 1941 and 1 plant inactive in 1941 but producing or shipping from stock on hand within the 7 previous years.

No new plants were reported producing in 1941. The total output for 1941 was 66.3 percent of the indicated capacity at the close of the year, based upon producers' reports; the corresponding figure for 1940 was 51.2 percent.

Plant capacity in 1941, by commercial districts, is indicated in the following table, with similar data for 1940.

The second table shows a grouping of plants by size.

Portland-cement-manufacturing capacity of the United States, 1940–41, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1940	1941	1940	1941
Eastern Pennsylvania, New Jersey, and Maryland	48,718,000	45,274,000	51.3	68.5
New York and Maine	17,408,000	17,244,000	50.5	69.6
Ohio, western Pennsylvania, and West Virginia	27,526,000	26,574,000	48.6	57.0
Michigan	15,196,000	14,055,000	56.6	67.5
Wisconsin, Illinois, Indiana, and Kentucky	29,724,000	28,267,000	42.6	57.4
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	25,786,000	24,512,000	57.1	81.5
Eastern Missouri, Iowa, Minnesota, and South Dakota	22,871,000	22,475,000	45.1	52.8
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	17,113,000	16,598,000	44.4	59.7
Texas	12,240,000	12,352,000	60.3	78.4
Colorado, Montana, Utah, Wyoming, and Idaho	5,690,000	5,815,000	52.1	68.0
California	24,040,000	26,290,000	59.1	75.8
Oregon and Washington	7,447,000	7,440,000	57.3	58.9
Puerto Rico	386,000	463,000	100.0	99.9
	254,145,000	247,359,000	51.2	66.3

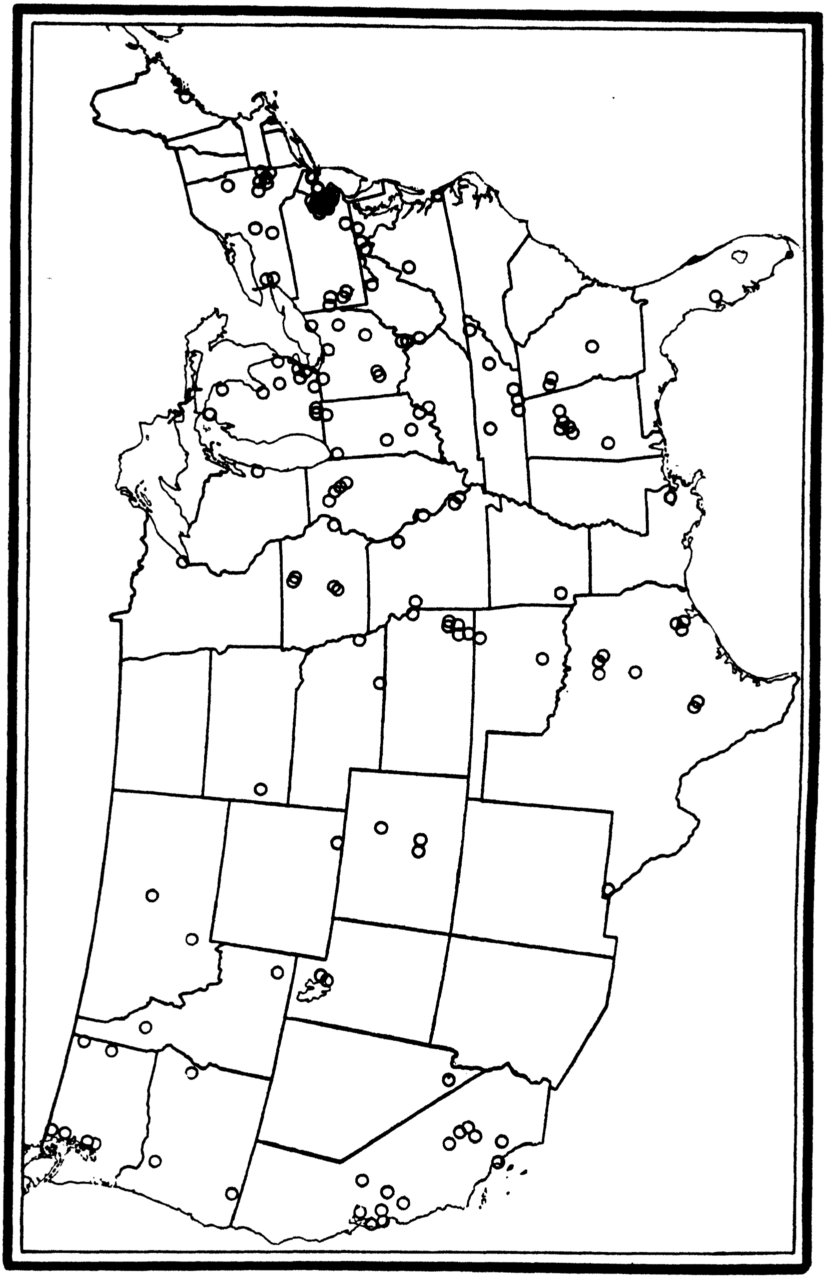

FIGURE 2.—Location of cement plants in the United States.

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Range of plant capacity for manufacture of finished portland cement in the United States in 1941

Estimated annual capacity, barrels:	Number of plants
Less than 1,000,000	38
1,000,000 to 1,999,000	83
2,000,000 to 2,999,000	23
Between 2,999,000 and 10,000,000	11
	155

The following estimates, based upon the monthly reports of producers, of the relationship between the production of finished portland cement and the manufacturing capacity of the industry for each month in 1940 and 1941 and for the 12 months ended with each month indicate the seasonal changes in capacity utilized.

Ratio (percent) of finished portland cement produced to manufacturing capacity of the United States, 1940–41

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1940	1941	1940	1941		1940	1941	1940	1941
January	29	42	48	53	July	56	75	48	60
February	[1] 26	43	48	54	August	58	77	48	61
March	36	50	47	56	September	62	78	49	62
April	47	59	48	57	October	64	79	49	64
May	58	69	48	57	November	60	73	50	65
June	59	74	48	58	December	51	65	51	66

[1] Revised figure.

The following table gives statistics of capacity, 1939–41, by the two general methods—the "wet" and the "dry"—used in manufacturing cement at plants in the United States.

Portland-cement-manufacturing capacity of the United States, 1939–41, by processes

Process	Estimated capacity						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1939	1940	1941	1939	1940	1941	1939	1940	1941	1939	1940	1941
Wet	121,337	122,266	121,065	47.3	48.1	48.9	51.8	55.4	70.3	51.4	52.0	51.9
Dry	135,085	131,879	126,294	52.7	51.9	51.1	43.9	47.4	62.5	48.6	48.0	48.1
	256,422	254,145	247,359	100.0	100.0	100.0	47.7	51.2	66.3	100.0	100.0	100.0

PRODUCTION ACCORDING TO RAW MATERIALS

In the accompanying table, production is classified according to the kinds of raw materials from which the cement is manufactured.

Type 1 includes cement produced from argillaceous limestone ("cement rock") or from a mixture of cement rock with pure limestone. This is the combination of materials used in all the cement plants of the Lehigh district of Pennsylvania and New Jersey, and a few plants in certain other States.

Type 2 includes cement made from a mixture of comparatively pure limestone with clay or shale. This mixture is employed at the majority of plants in the United States. In 1941 four plants reported the use of oystershells and clay; the output of these plants is included in type 2.

Type 3 includes cement manufactured from a mixture of marl and clay. This type of mixture has been used in certain plants in Michigan, Ohio, Indiana, New York, and Virginia.

Type 4 includes portland cement manufactured from a mixture of limestone and blast-furnace slag.

Production and percent of total output of portland cement in the United States, 1898–1914, 1926, 1929, 1933, 1935, and 1941, according to types of material used

Year	Type 1 Cement rock and pure limestone		Type 2. Limestone and clay or shale		Type 3. Marl and clay		Type 4. Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
1898	2,764,694	74.9	365,408	9.9	562,092	15.2		
1899	4,010,132	70.9	546,200	9.7	1,095,934	19.4		
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,209	16.1	2,001,200	15.7	164,316	1.3
1902	10,953,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	55.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1905	18,454,902	52.4	11,172,389	31.7	3,884,178	11.0	1,735,343	4.9
1906	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,693	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9
1909	24,274,047	37.3	32,219,365	49.6	2,711,219	4.2	5,786,800	8.9
1910	26,520,911	34.6	39,720,320	51.9	3,307,220	4.3	7,001,500	9.2
1911	26,812,129	34.1	40,665,332	51.8	3,314,176	4.2	7,737,000	9.9
1912	24,712,780	30.0	44,607,776	54.1	2,467,368	3.0	10,650,172	12.9
1913	29,333,490	31.8	47,831,863	51.9	3,734,778	4.1	11,197,000	12.2
1914	24,907,047	28.2	50,168,813	56.9	4,038,310	4.6	9,116,000	10.3
1926	44,090,657	26.8	[1] 101,637,866	61.8	3,324,408	2.0	15,477,239	9.4
1929	51,077,034	29.9	[1] 97,623,502	57.2	4,832,700	2.9	17,112,800	10.0
1933	14,135,171	22.3	[1] 43,638,023	68.7	1,402,744	2.2	4,297,251	6.8
1935	23,811,687	31.0	[1] 45,073,144	58.8	1,478,569	1.9	6,378,170	8.3
1941	46,534,193	28.4	[1] 102,285,699	62.4	3,142,021	1.9	12,068,646	7.4

[1] Includes output of 2 plants using oystershells and clay in 1926; 3 plants in 1929, 1933, and 1935; and 4 plants in 1941

RAW MATERIALS

The producers reported that approximately 52,755,253 short tons of raw materials (exclusive of fuels and explosives) entered into the manufacture of 164,030,559 barrels (30,837,745 short tons) of portland cement in the United States in 1941—an average of about 643 pounds to a barrel (376 pounds) of finished cement. The totals for 1941, with corresponding figures for 1940 (in parentheses) follow: 42,733,707 tons of limestone and cement rock (34,040,119 tons, revised figure); 4,726,192 tons of clay and shale (4,016,427 tons, revised figure); 659,201 tons of blast-furnace slag (581,873 tons); 1,066,635 tons of marl (932,339 tons); 1,035,179 tons of gypsum (807,938 tons, revised figure); and 2,534,339 tons of other materials, such as oystershells, sandstone, sand, cinders, fluorspar, iron ore, diatomaceous shale, pumicite, fuller's earth, bentonite, silica, quartz, ashes, pyrite ore, pyrite cinder, roll scale, calcium chloride, and hydrated lime (1,878,651 tons, revised figure).

FUELS AND POWER

Fuels.—According to monthly reports of producers, supplemented by a few estimates by the Bureau of Mines, the following quantities of fuel were consumed at portland-cement plants in the United States and Puerto Rico in 1941 in making 163,629,000 barrels of clinker (unground cement) and 164,030,559 barrels of finished cement: Coal, 6,831,825 short tons; oil, 3,552,030 barrels (42 gallons); and natural gas, 54,207,900,833 cubic feet. Corresponding figures for 1940 are: Clinker produced, 130,141,000 barrels, and finished cement produced, 130,216,511 barrels. Fuels consumed were: Coal, 5,633,156 short tons; oil, 2,424,976 barrels; and natural gas, 41,948,699,007 cubic feet.

The first and second of the accompanying tables on fuels compare the output of clinker and finished cement in 1940 and 1941 with the estimated fuel consumption by processes. Similar data were published in Statistical Appendix to Minerals Yearbook, 1935 (p. 200), covering 1933 and 1934. The third table on fuels shows detailed data on quantities used in 1940 and 1941.

Cement clinker (unground cement) produced and in stock at mills in the United States, 1940–41, by processes, in barrels of 376 pounds [1]

Process	Number of plants		Production		Stock (Dec. 31)	
	1940	1941	1940	1941	1940 [2]	1941 [3]
Wet	87	90	67,905,000	84,568,000	2,847,000	2,508,000
Dry	65	65	62,236,000	79,061,000	2,039,000	2,075,000
	152	155	130,141,000	163,629,000	4,886,000	4,583,000

[1] Compiled from monthly estimates of the producers.
[2] Revised figures.
[3] Subject to revision.

Portland cement burned and fuels used in the United States, 1940–41, by processes

Process	Finished cement produced			Fuel consumed [1]		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1940						
Wet	87	67,689,498	52.0	[2] 2,818,216	1,385,702	25,821,525,307
Dry	65	62,527,013	48.0	2,814,940	1,039,274	16,127,173,700
	152	130,216,511	100.0	[3] 5,633,156	2,424,976	41,948,699,007
1941						
Wet	90	85,153,919	51.9	[4] 3,325,823	2,090,700	34,045,968,833
Dry	65	78,876,640	48.1	3,506,002	1,461,330	20,161,932,000
	155	164,030,559	100.0	[5] 6,831,825	3,552,030	54,207,900,833

[1] Figures compiled from monthly estimates of the producers.
[2] In addition to the coal shown for this group, 1 plant reported the use of petroleum coke with coal and natural gas.
[3] Includes 74,437 short tons of anthracite and 5,558,719 short tons of bituminous coal.
[4] In addition to the coal shown for this group, 2 plants reported the use of petroleum coke with coal and natural gas.
[5] Includes 96,768 short tons of anthracite and 6,735,057 short tons of bituminous coal.

Portland cement burned in the United States, 1940–41, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed [1]		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1940						
Coal	99	[2] 83,864,320	64.4	5,009,265		
Oil	11	[2] 9,426,674	7.2		2,049,203	
Natural gas	15	[2] 11,758,348	9.0			18,350,001,017
Coal and oil	5	6,765,481	5.2	410,278	230,446	
Coal and natural gas [3]	15	11,384,238	8.8	211,015		14,125,049,790
Oil and natural gas	4	} 7,017,450	} 5.4		112,305	7,017,663,200
Coal, oil, and natural gas	3			2,598	33,022	2,455,985,000
	152	130,216,511	100.0	[4] 5,633,156	2,424,976	41,948,699,007
1941						
Coal	102	[2] 104,385,531	63.6	6,193,207		
Oil	11	[2] 11,341,543	6.9		2,524,587	
Natural gas	15	[2] 14,933,181	9.1			22,127,284,511
Coal and oil	6	9,501,559	5.8	508,571	567,318	
Coal and natural gas [5]	15	13,454,345	8.2	128,659		19,666,186,322
Oil and natural gas	5	} 10,414,400	} 6.4		422,223	11,073,254,000
Coal, oil, and natural gas	1			1,388	37,902	1,341,176,000
	155	164,030,559	100.0	[6] 6,831,825	3,552,030	54,207,900,833

[1] Figures compiled from monthly estimates of the producers.
[2] Average consumption of fuel per barrel of cement produced was as follows: 1940—coal, 119.5 pounds; oil, 0.2174 barrel, natural gas, 1,561 cubic feet. 1941—coal, 118.7 pounds; oil, 0.2226 barrel; natural gas, 1,482 cubic feet
[3] In addition to the coal and natural gas included for this group, 1 plant reported the use of petroleum coke with coal and natural gas
[4] Includes 74,437 short tons of anthracite and 5,558,719 short tons of bituminous coal.
[5] In addition to the coal and natural gas included for this group, 2 plants reported the use of petroleum coke with coal and natural gas.
[6] Includes 96,768 short tons of anthracite and 6,735,057 short tons of bituminous coal

Electric power.—The accompanying table gives the electric energy produced at portland-cement plants and that purchased from power companies during 1940 and 1941. The cement industry generated 47 percent of its electric-power requirements in 1941 compared with 49 percent in 1940 and 50 percent in 1939.

Electric energy used at portland-cement-producing plants in the United States, 1940–41, by processes, in kilowatt-hours

Process	Electric energy used						Finished cement produced	Average electric energy used per barrel of cement produced
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent	Barrels	Kilowatt-hours
1940								
Wet	33	[1] 573,045,020	72	970,439,295	[1] 1,543,484,315	51.9	67,689,498	22.8
Dry	36	887,343,326	52	544,500,540	1,431,843,866	48.1	62,527,013	22.9
	69	[1] 1,460,388,346	124	1,514,939,835	[1] 2,975,328,181	100.0	130,216,511	22.8
Percent of total electric energy used		49.1		50.9	100.0			
1941								
Wet	32	643,610,788	74	1,224,801,790	1,868,412,578	51.3	85,153,919	21.9
Dry	36	1,076,033,868	54	700,009,725	1,776,043,593	48.7	78,876,640	22.5
	68	1,719,644,656	128	1,924,811,515	3,644,456,171	100.0	164,030,559	22.2
Percent of total electric energy used		47.2		52.8	100.0			

[1] Revised figures.

SPECIAL CEMENTS

In addition to the regular standard portland cements that constitute the great bulk of production, several special varieties of cement also are manufactured. They are designed to satisfy unusual demands, for instance, in high-early-strength cement where time is an important element; in low- and moderate-heat-of-hardening cement for monolithic structures; and in puzzolan cements for use in places where resistance to chemical attack is demanded. These and other special varieties were discussed in some detail in the chapter on Cement in Minerals Yearbook, Review of 1940 (pp. 1125–1127). Accordingly the discussion is restricted this year to data on certain masonry cements, the statistics for which do not appear in the accompanying table. The types referred to are certain masonry cements that are not true portlands but employ portland-cement clinker and finished portland cement as a base. To this base are added considerable quantities of lime or other constituents of various kinds. These specially prepared masonry cements are sold under proprietary names. Production, which was reported from 52 plants in 1941, totaled 3,097,382 barrels and shipments 3,080,605 barrels valued at $4,636,497—an average of $1.51 a barrel. Corresponding data for 1940, representing the output of 44 plants (revised figure) are: Production, 2,312,155 barrels, and shipments 2,260,636 barrels valued at $3,175,088—an average of $1.40 a barrel. As the finished portland cement and clinker used in making these types of masonry cement have been reported elsewhere by producers, to avoid duplication the above figures are not included in the totals.

The following table presents statistical data for recent years insofar as they are available covering special portland cements. All the figures except those for masonry cement (hydraulic but not portland) and "masonry natural" are included in the general tables earlier in this chapter.

Special portland cements produced and shipped in the United States, 1937–41, by kinds

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
High-early-strength					
1937	64	4,192,959	3,845,314	$7,134,468	$1.86
1938	72	3,340,582	3,385,523	6,247,699	1.85
1939	79	3,780,716	3,693,460	6,964,608	1.89
1940	88	[1] 4,478,797	[1] 4,401,449	[1] 8,243,315	1.87
1941	90	6,063,638	6,123,224	11,443,792	1.87
Masonry or mortar					
1937	10	257,385	273,144	362,807	1.33
1938	5	84,875	88,905	124,239	1.40
1939	5	173,737	155,781	211,711	1.36
1940	5	219,480	214,303	308,333	1.44
1941					
Low and moderate-heat:					
1937	27	3,158,165	3,499,340	4,989,425	1.43
1938	38	4,181,568	3,808,927	5,710,698	1.50
1939	43	5,564,921	5,761,840	8,237,440	1.43
1940	55	[1] 8,559,487	[1] 7,709,503	[1] 10,307,976	1.34
1941	58	11,290,232	11,177,651	14,963,940	1.34

[1] Revised figures

Special portland cements produced and shipped in the United States, 1937–41, by kinds—Continued

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
Portland-puzzolan:					
1937	8	263,877	298,067	$423,297	$1.42
1938	9	198,268	185,664	285,088	1.54
1939	9	337,187	321,217	434,281	1.35
1940	10	413,870	412,143	552,830	1.34
1941	8	441,500	439,354	632,713	1.44
Oil-well:					
1937	10	342,316	313,064	652,960	2.09
1938	8	238,966	232,319	481,401	2.07
1939	12	375,866	375,027	710,032	1.89
1940	22	711,348	719,022	1,365,840	1.90
1941	19	786,167	806,364	1,550,301	1.92
Sulfate-resisting:					
1937	2	(2)	(2)	(2)	(2)
1938	3	(2)	(2)	(2)	(2)
1939	4	38,279	27,362	57,867	2.11
1940	11	193,348	200,090	316,280	1.58
1941	9	342,400	353,885	544,767	1.54
Miscellaneous:					
1937	14	641,960	648,973	1,014,058	1.56
1938	15	642,854	625,860	1,004,393	1.60
1939	15	755,833	775,179	1,067,699	1.38
1940	[1] 13	580,502	577,579	755,764	1.31
1941	14	668,655	667,206	1,058,108	1.59

[1] Revised figures.
[2] Bureau of Mines not at liberty to publish figures separately.

NEW DEVELOPMENTS

Large-scale rehabilitation and modernization programs are in progress or have been completed recently by at least six cement companies, and less extensive improvements have been made by many others. A large number of mills are now equipped with unit coal pulverizers that discharge directly into the kilns. This is one of the most outstanding recent improvements in plant design. Automatic control of all elements pertaining to the preparation of raw materials, calcination, and clinker grinding is attaining increased refinements, owing partly to the necessity of meeting exacting specifications and partly to the need for more efficient combustion and plant operation.

In certain localities the demand for cement has been so active that it is delivered on the job within a relatively short time after it is made. Consequently, some difficulty has been experienced because recent specifications in force at some consuming centers require cement to be delivered on the job at a temperature not higher than 125° F., whereas formerly 140° F. was allowed. At least one company has introduced the use of finished-cement coolers.

Other important developments include a wider use of cement-mill stack dust as a cement raw material and the introduction of a Lepol kiln at the plant of the Santa Cruz Portland Cement Co., Davenport, Calif. This installation is the second one of this type of equipment in the United States, the first being that of the Spokane Portland Cement Co., Irvin, Wash., introduced in 1935.

Further progress has been made in air-quenching hot clinker. The advantages are (1) reduction in grinding cost; (2) fuel conservation

(heat from the clinker being transferred to the kilns in a secondary air supply); and (3) improved quality of the cement as indicated by higher soundness tests.

Concrete ships gave unsatisfactory service in the World War of 1914–18, but their use has not been abandoned because of the failures of that period. They are again being built; and it is believed that those now under construction will give useful service, because the design has been improved, and the cement used is of higher quality than that which was available 25 years ago. The first concrete ships built during the present war were designed as tow barges, but more recently the Maritime Commission let contracts for 24 self-propelled seagoing craft, each of 5,200 tons. They will be built in a new shipyard at Tampa, Fla.

White cement is now used for the finishing coat on concrete floors in airplane factories. The reflected light from such floor surfaces is of great assistance to those constructing the underside of wings and fuselage.

Much progress has been made in the substitution of cement for iron, steel, or other metals urgently needed for military uses. The newer products include storage tanks for household oil burners, bleach tanks for laundries, septic tanks, bath tubs, and sash weights. A new type of manhole cover has been devised which requires only 15 to 20 pounds of reinforcing steel, whereas the ordinary 24-inch iron cover contains 85 to 100 pounds of metal.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

The term "natural" is used to designate certain cements made by calcining argillaceous limestone at a comparatively low temperature and pulverizing the calcined material. Some of them have special properties that adapt them to mortar uses for laying brick and stone; therefore, they are classed as masonry (natural) cements.

Another special non-portland cement consists of a mixture of blast-furnace slag and hydrated lime. It is classed with the puzzolan cements.

Producers of these special non-portland cements reported that 48,091 short tons of coal and the gas equivalent of about 89 short tons of coal were used in their manufacture in 1941. Fuel consumed in 1940 totaled 42,873 short tons of coal and the gas equivalent of about 68 short tons of coal.

Production and shipments of these special types of cement combined are indicated in the following table.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1937–41

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1937	12	1,900,643	1,873,400	$2,578,885	253,518
1938	12	1,820,795	1,867,949	2,725,776	373,816
1939	12	2,439,110	2,405,135	3,361,724	239,938
1940	12	2,534,566	2,514,597	3,386,801	[1] 259,868
1941	12	2,875,962	2,926,203	3,967,567	209,627

[1] Revised figure.

TRENDS IN EMPLOYMENT AND OUTPUT PER MAN[1]

In Minerals Yearbook, 1935 (pp. 891–905) and 1940, Review of 1939 (pp. 1141–1153), trends in employment and output per man in the cement industry were traced from 1928 to 1938. The following data extend this 11-year period through 1939 and 1940.

GENERAL DATA

As may be noted in the first table, the number of men employed was greater in 1940 than in 1938 or 1939. The average number of days worked also was greater, but the average length of day has varied only slightly for several years. The average output of cement per man has increased progressively since 1937.

Employment in the portland-cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1936–40

Year	Employment					Production			Percent of industry represented [1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1936	25,406	272	6,917,074	7.3	50,688,870	111,238,300	16.08	2.19	98.7
1937	26,432	279	7,380,028	7.4	54,714,935	116,174,708	15.74	2.12	100.0
1938	25,036	256	6,398,178	7.5	47,729,779	105,357,000	16.47	2.21	100.0
1939 [2]	25,503	273	6,974,191	7.3	51,184,194	121,934,911	17.48	2.38	99.7
1940 [2]	26,038	279	7,276,469	7.4	54,116,153	129,830,687	17.84	2.40	99.7

[1] Calculated for each year by dividing quantity of finished cement produced at mills included in study by total production. [2] Exclusive of Puerto Rico.

MILL EMPLOYEES

In 1928 mill employees averaged 9.5 hours a day for 332 days and produced 1.98 barrels of finished cement per man-hour; in 1940 they averaged 7.4 hours a day for only 287 days but produced 2.95 barrels of cement per man-hour. Thus productivity per man per hour increased 49 percent during this 13-year period.

Mill employees in the portland-cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1936–40

Year	Employment—cement mill only					Production			Percent of industry represented [1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1936	19,881	280	5,564,582	7.3	40,634,045	111,029,026	19.95	2.73	98.6
1937	20,925	289	6,041,237	7.4	44,553,173	116,174,708	19.23	2.61	100.0
1938	19,828	264	5,224,790	7.4	38,866,410	105,357,000	20.16	2.71	100.0
1939 [2]	20,186	282	5,691,718	7.3	41,518,750	121,934,911	21.42	2.94	99.7
1940 [2]	20,692	287	5,930,723	7.4	43,967,729	129,830,687	21.89	2.95	99.7

[1] Calculated for each year by dividing quantity of finished cement produced at mills included in study by total production. [2] Exclusive of Puerto Rico.

[1] Statistics on employment and output per man presented in this discussion were compiled by E. T. Shuey from records of the employment statistics section, Bureau of Mines.

QUARRY AND CRUSHER EMPLOYEES

From 1929—the first year for which data are available—to 1940 the number of quarry and crusher employees dropped from 5,123 to 4,394, the average hours per day declined from 9.6 to 7.6, but the tonnage of material handled per man per hour increased from 3.20 to 4.14. This increase no doubt reflects increased mechanization and greater efficiency.

Quarry and crusher employees in the portland-cement industry, material (quarry rock and overburden) handled at quarries included in study, and average output of material per man in the United States, 1936–40

Year	Employment—quarry and crusher only					Material handled—quarry rock and overburden				Percent of industry represented[1]
	Average number of men	Time employed				Short tons	Percent of overburden included	Average per man (short tons)		
		Average number of days	Total man-shifts	Man-hours				Per shift	Per hour	
				Average per man per day	Total					
1936	5,023	246	1,233,219	7.4	9,174,710	(2)	(2)	(2)	(2)	98.7
1937	4,980	242	1,203,867	7.6	9,169,763	(2)	(2)	(2)	(2)	90.0
1938	4,442	218	968,873	7.6	7,384,387	(2)	(2)	(2)	(2)	90.3
1939[3]	4,433	234	1,037,183	7.6	7,904,793	31,952,378	3.9	30.81	4.04	85.3
1940[3]	4,394	244	1,070,881	7.6	8,171,104	33,804,500	2.6	31.57	4.14	82.6

[1] Calculated for each year by dividing quantity of finished cement produced at mills included in study by total production.
[2] Figures not available.
[3] Exclusive of Puerto Rico

HOURS PER DAY

A remarkable change has taken place in the average number of hours per day of employment. In 1928, 58 percent of the employees worked more than 9 hours a day; in 1940, only 2 percent. In 1928, 23 percent of the employees had a working day of 11 to 12 hours; in 1940, no employees worked more than 10 hours a day.

Number of men employed in the portland-cement industry in the United States and output per man-hour, 1938–40, classified according to hours of labor per day

Hours per day	1938			1939[1]			1940[1]		
	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)
	Number	Percent of total		Number	Percent of total		Number	Percent of total	
Less than 6	319	1.3	2.7	867	3.4	2.50	681	2.6	2.44
6 and less than 7	6,375	25.5	2.2	7,958	31.2	2.42	6,282	24.1	2.62
7 and less than 8	5,608	22.4	2.3	4,345	17.0	2.36	4,679	18.0	2.20
8 and less than 9	12,124	48.4	2.2	12,333	48.4	2.36	14,263	54.8	2.37
9 and less than 10	610	2.4	1.6				133	.5	2.29
	25,036	100.0	2.2	25,503	100.0	2.38	26,038	100.0	2.40

[1] Exclusive of Puerto Rico.

DISTRICT AND STATE TABLES

The following tables show a geographic break-down, by districts and States, of the statistical record of employment and productivity of labor in the cement industry. These data are primarily of interest in the study of regional relationships. The first table, covering employment in the portland-cement industry as a whole, and the second, relating to mill employees, give data for 1939 and 1940 supplementing similar figures for 1928 to 1933 in Minerals Yearbook, 1935 (pp. 897–902), and for 1934 to 1938 in Minerals Yearbook, 1940, Review of 1939 (pp. 1145–1152). The third table, comprising data for quarry and crusher employees in 1939 and 1940, supplements similar data for 1929 to 1933 in Minerals Yearbook, 1935 (pp. 903–905), and for 1934 in Minerals Yearbook, 1940, Review of 1939 (p. 1153); data for 1935 to 1938 are lacking.

Employment in the portland-cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1939–40, by districts and by States (excluding Puerto Rico)

District and State	Employment					Production			Percent of industry represented[1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1939									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	5,305	286	1,519,200	6.8	10,277,957	23,650,626	15.57	2.30	100.0
New York and Maine	1,570	255	400,941	7.7	3,086,473	7,315,716	18.25	2.37	100.0
Ohio, western Pennsylvania, and West Virginia	2,895	267	772,727	7.7	5,987,344	11,339,742	14.67	1.89	100.0
Michigan	1,712	291	498,356	7.8	3,879,845	8,218,760	16.49	2.12	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,531	274	693,453	7.1	4,898,182	12,276,018	17.70	2.51	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,943	258	758,965	7.4	5,607,834	13,349,464	17.58	2.38	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,367	271	640,394	7.4	4,729,626	10,474,558	16.36	2.21	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,665	269	447,766	7 4	3,315,030	8,038,885	17.95	2.42	100.0
Texas	1,287	269	346,442	7.5	2,600,919	7,337,246	21.18	2.82	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	634	258	163,274	7.4	1,208,928	3,062,889	18.76	2.53	100.0
California	1,716	290	496,962	7.6	3,797,983	10,990,079	22.11	2.89	100.0
Oregon and Washington	878	268	235,711	7.6	1,794,073	5,880,928	24.95	3.28	100.0
	25,503	273	6,974,191	7.3	51,184,194	121,934,911	17.48	2.38	99.7
STATE									
Alabama	995	255	254,067	7.1	1,791,889	5,038,400	19.83	2.81	100.0
California	1,716	290	496,962	7.6	3,797,983	10,990,079	22.11	2.89	100.0
Illinois	1,034	264	273,226	6.4	1,748,736	4,648,834	17.01	2.66	100.0
Iowa	1,195	263	313,835	7.7	2,416,166	4,718,024	15.03	1.95	100.0

See footnotes at end of table.

Employment in the portland-cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1939-40, by districts and by States (excluding Puerto Rico)—Continued

District and State	Employment: Average number of men	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per man per day	Man-hours: Total	Production: Finished portland cement (barrels)	Average per man (barrels): Per shift	Average per man (barrels): Per hour	Percent of industry represented[1]
1939									
STATE—continued									
Kansas	798	255	204, 684	7. 9	1, 604, 777	3, 739, 004	18. 27	2. 38	100. 0
Michigan	1, 712	291	498, 356	7. 8	3, 879, 845	8, 218, 760	16. 49	2. 12	100. 0
Missouri	1, 048	279	291, 923	7. 1	2, 063, 735	4, 785, 594	16. 39	2. 32	100. 0
New York	1, 454	256	372, 006	7. 6	2, 844, 398	6, 867, 614	18. 46	2. 41	100. 0
Ohio	1, 378	284	391, 588	7. 8	3, 041, 347	5, 799, 726	14. 81	1. 91	100. 0
Pennsylvania	5, 437	282	1, 531, 712	6 9	10, 624, 846	25, 105, 902	16. 39	2. 36	100. 0
Tennessee	748	269	201, 172	7. 6	1, 533, 566	3, 537, 208	17. 58	2. 31	100. 0
Texas	1, 287	269	346, 442	7. 5	2, 600, 919	7, 337, 246	21. 18	2. 82	100. 0
Other States[2]	6, 701	268	1, 798, 218	7. 4	13, 235, 987	31, 148, 520	17. 32	2. 35	100. 0
	25, 503	273	6, 974, 191	7. 3	51, 184, 194	121, 934, 911	17. 48	2. 38	99. 7
1940									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	5, 280	293	1, 549, 450	6. 9	10, 767, 007	24, 970, 132	16. 12	2. 32	100. 0
New York and Maine	1, 714	264	452, 808	7. 9	3, 572, 428	8, 784, 509	19. 40	2. 46	100. 0
Ohio, western Pennsylvania, and West Virginia	3, 042	278	845, 251	7. 7	6, 514, 883	13, 374, 846	15. 82	2. 05	100. 0
Michigan	1, 666	302	502, 428	8. 0	3, 996, 875	8, 603, 188	17. 12	2. 15	100. 0
Wisconsin, Illinois, Indiana, and Kentucky	2, 478	287	710, 579	7. 0	4, 966, 295	12, 663, 788	17. 82	2. 55	100. 0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	3, 083	265	816, 568	7. 4	6, 027, 203	14, 710, 971	18. 02	2. 44	100. 0
Eastern Missouri, Iowa, Minnesota, and South Dakota	2, 324	265	616, 856	7. 4	4, 551, 707	10, 304, 229	16. 70	2. 26	100. 0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1, 613	257	413, 905	7. 7	3, 175, 195	7, 597, 759	18. 36	2. 39	100. 0
Texas	1, 326	267	353, 480	7. 7	2, 711, 953	7, 374, 886	20. 86	2. 72	100. 0
Colorado Montana, Utah, Wyoming, and Idaho	578	256	147, 859	7. 5	1, 108, 087	2, 961, 823	20. 03	2. 67	100. 0
California	2, 102	316	664, 436	7. 8	5, 182, 516	14, 215, 745	21. 40	2. 74	100. 0
Oregon and Washington	832	244	202, 849	7. 6	1, 542, 004	4, 268, 811	21. 04	2 77	100. 0
	26, 038	279	7, 276, 469	7. 4	54, 116, 153	129, 830, 687	17. 84	2. 40	99. 7
STATE									
Alabama	1, 019	256	260, 766	6. 9	1, 804, 199	5, 122, 307	19. 64	2. 84	100. 0
California	2, 102	316	664, 436	7. 8	5, 182, 516	14, 215, 745	21 40	2. 74	100. 0
Illinois	979	286	280, 227	6. 4	1, 788, 551	4, 974, 917	17. 75	2. 78	100. 0
Iowa	1, 150	252	290, 208	7. 8	2, 259, 916	4, 605, 886	15. 87	2. 04	100. 0
Kansas	773	238	184, 297	8 2	1, 509, 762	3, 433, 033	19. 71	2. 27	100. 0
Michigan	1, 666	302	502, 428	8 0	3, 996, 875	8, 603, 188	17. 12	2. 15	100. 0
Missouri	1, 099	268	294, 965	7. 0	2, 077, 227	4, 968, 106	16 84	2. 39	100. 0
New York	1, 607	267	428, 757	7. 9	3, 380, 030	8, 437, 368	19. 68	2. 50	100. 0
Phio	1, 415	282	398, 706	7. 8	3, 090, 286	6, 664, 115	16. 72	2. 16	100. 0
Tennsylvania	5, 541	290	1, 605, 037	7. 0	11, 298, 655	26, 853, 002	16. 73	2. 38	100. 0
Tennessee	768	268	205, 776	8. 0	1, 639, 531	3, 808, 307	18. 51	2. 32	100. 0
Oexas	1, 326	267	353, 480	7. 7	2, 711, 953	7, 374, 886	20. 86	2. 72	100. 0
Other States[2]	6, 593	274	1, 807, 386	7. 4	13, 376, 652	30, 769, 827	17. 02	2. 30	100. 0
	26, 038	279	7, 276, 469	7. 4	54, 116, 153	129, 830, 687	17. 84	2. 40	99. 7

[1] Calculated for each year by dividing quantity of finished cement produced at mills included in study by total production.

[2] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Mill employees in the portland-cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1939–40, by districts and by States (excluding Puerto Rico)

District and State	Employment—cement mill only					Production			Per cent of industry represented [1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1939									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4, 347	294	1, 276, 161	6. 6	8, 475, 081	23, 650, 626	18. 53	2. 79	100. 0
New York and Maine	1, 266	262	332, 035	7. 7	2, 556, 160	7, 315, 716	22. 03	2. 86	100. 0
Ohio, western Pennsylvania, and West Virginia	2, 075	275	571, 315	7. 7	4, 400, 659	11, 339, 742	19. 85	2. 58	100. 0
Michigan	1, 478	300	442, 907	7. 8	3, 444, 296	8, 218, 760	18. 56	2. 39	100. 0
Wisconsin, Illinois, Indiana, and Kentucky	2, 215	279	617, 212	7. 1	4, 373, 453	12, 276, 018	19. 89	2. 81	100. 0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2, 211	266	588, 285	7. 3	4, 321, 454	13, 349, 464	22. 69	3. 09	100. 0
Eastern Missouri, Iowa, Minnesota, and South Dakota	1, 849	287	530, 164	7. 3	3, 888, 127	10, 474, 558	19. 76	2. 69	100. 0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1, 337	276	368, 719	7. 4	2, 717, 365	8, 038, 885	21. 80	2. 96	100. 0
Texas	996	272	270, 805	7. 7	2, 073, 732	7, 337, 246	27. 09	3. 54	100. 0
Colorado, Montana, Utah, Wyoming, and Idaho	479	258	123, 424	7. 6	935, 555	3, 062, 889	24. 82	3. 27	100. 0
California	1, 288	302	389, 272	7. 6	2, 971, 103	10, 990, 079	28. 23	3. 70	100. 0
Oregon and Washington	645	281	181, 419	7. 5	1, 361, 765	5, 880, 928	32. 42	4. 32	100. 0
	20, 186	282	5, 691, 718	7. 3	41, 518, 750	121, 934, 911	21. 42	2. 94	99. 7
STATE									
Alabama	759	268	203, 780	6. 9	1, 396, 163	5, 038, 400	24. 72	3. 61	100. 0
California	1, 288	302	389, 272	7. 6	2, 971, 103	10, 990, 079	28. 23	3. 70	100. 0
Illinois	868	270	234, 480	6. 3	1, 483, 833	4, 648, 834	19. 83	3. 13	100. 0
Iowa	905	275	248, 969	7. 6	1, 904, 494	4, 718, 024	18. 95	2. 48	100. 0
Kansas	634	260	164, 789	7. 8	1, 292, 111	3, 739, 004	22. 69	2. 89	100. 0
Michigan	1, 478	300	442, 907	7. 8	3, 444, 296	8, 218, 760	18. 56	2. 39	100. 0
Missouri	836	298	248, 723	7. 0	1, 742, 963	4, 785, 594	19. 24	2. 75	100. 0
New York	1, 175	261	306, 917	7. 6	2, 344, 620	6, 867, 614	22. 38	2. 93	100. 0
Ohio	1, 110	297	330, 196	7. 7	2, 554, 330	5, 799, 726	17. 56	2. 27	100. 0
Pennsylvania	4, 408	291	1, 281, 143	6. 8	8, 730, 180	25, 105, 902	19. 60	2. 88	100. 0
Tennessee	567	280	158, 851	7. 4	1, 183, 038	3, 537, 208	22. 27	2. 99	100. 0
Texas	996	272	270, 805	7. 7	2, 073, 732	7, 337, 246	27. 09	3. 54	100. 0
Other States [2]	5, 162	273	1, 410, 886	7. 4	10, 397, 887	31, 148, 520	22. 08	3. 00	100. 0
	20, 186	282	5, 691, 718	7. 3	41, 518, 750	121, 934, 911	21. 42	2. 94	99. 7
1940									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4, 312	301	1, 296, 255	6. 8	8, 860, 080	24, 970, 132	19. 26	2. 82	100. 0
New York and Maine	1, 415	270	382, 370	7. 9	3, 037, 580	8, 784, 509	22. 97	2. 89	100. 0
Ohio, western Pennsylvania, and West Virginia	2, 161	283	611, 778	7. 7	4, 690, 343	13, 374, 846	21. 86	2. 85	100. 0
Michigan	1, 429	308	439, 581	8. 0	3, 516, 650	8, 603, 188	19. 57	2. 45	100. 0
Wisconsin, Illinois, Indiana, and Kentucky	2, 093	291	609, 042	7. 1	4, 300, 369	12, 663, 788	20. 79	2. 94	100. 0

See footnotes at end of table.

Mill employees in the portland-cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1939–40, by districts and by States (excluding Puerto Rico)—Continued

District and State	Employment—cement mill only: Average number of men	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per man per day	Man-hours: Total	Production: Finished portland cement (barrels)	Average per man (barrels): Per shift	Average per man (barrels): Per hour	Per cent of industry represented[1]
1940									
DISTRICT—continued									
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,325	269	624,580	7.3	4,558,497	14,710,971	23.55	3.23	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	1,919	274	526,589	7.4	3,877,577	10,304,229	19.57	2 66	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,282	263	337,559	7.6	2,581,558	7,597,759	22.51	2.94	100.0
Texas	1,033	273	282,092	7.8	2,191,595	7,374,886	26.14	3.37	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	438	258	112,851	7.6	860,958	2,961,823	26.25	3.44	100.0
California	1,660	330	547,926	7.8	4,288,886	14,215,745	25.94	3.31	100.0
Oregon and Washington	625	256	160,100	7.5	1,203,630	4,268,811	26.66	3.55	100.0
	20,692	287	5,930,723	7.4	43,967,729	129,830,687	21.89	2.95	99.7
STATE									
Alabama	786	268	210,893	6.8	1,423,629	5,122,307	24.29	3 60	100.0
California	1,660	330	547,926	7.8	4,288,886	14,215,745	25.94	3.31	100.0
Illinois	765	293	224,013	6.4	1,431,113	4,974,917	22.21	3 48	100.0
Iowa	965	258	248,883	7.8	1,938,286	4,605,886	18.51	2.38	100.0
Kansas	616	242	148,956	8.2	1,221,223	3,433,033	23.05	2.81	100.0
Michigan	1,429	308	439,581	8.0	3,516,650	8,603,188	19.57	2 45	100.0
Missouri	891	279	249,010	7.0	1,739,462	4,968,106	19.95	2.86	100.0
New York	1,327	272	361,418	7.9	2,869,972	8,437,368	23.35	2 94	100.0
Ohio	1,112	289	321,313	7.7	2,487,754	6,664,115	20 74	2 68	100.0
Pennsylvania	4,480	298	1,336,573	6.9	9,272,320	26,853,002	20.09	2.90	100.0
Tennessee	568	270	153,481	8.0	1,222,337	3,808,307	24.81	3.12	100.0
Texas	1,033	273	282,092	7.8	2,191,595	7,374,886	26.14	3 37	100.0
Other States[2]	5,060	278	1,406,584	7.4	10,364,502	30,769,827	21.88	2.97	100.0
	20,692	287	5,930,723	7.4	43,967,729	129,830,687	21.89	2.95	99.7

[1] Calculated for each year by dividing quantity of finished cement produced at mills included in study by total production.

[2] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Quarry and crusher employees in the portland-cement industry, material (quarry rock and overburden) handled at quarries included in study, and average output of material per man in the United States, 1939–40, by districts and by States (excluding Puerto Rico)

District and State	Employment—quarry and crusher only: Average number of men	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per man per day	Man-hours: Total	Material handled—quarry rock and overburden: Short tons	Percent of overburden included	Average per man (short tons): Per shift	Average per man (short tons): Per hour	Percent of industry represented[1]
1939										
DISTRICT										
Eastern Pennsylvania, New Jersey, and Maryland	832	246	204, 379	7 7	1, 564, 080	6, 408, 686	2. 9	31. 36	4. 10	96. 0
New York and Maine	244	220	53, 770	7 7	412, 666	1, 914, 288	5 8	35. 60	4. 64	100. 0
Ohio, western Pennsylvania, and West Virginia	728	238	173, 621	7 9	1, 364, 361	3, 505, 461	3 8	20 19	2. 57	74. 1
Michigan	128	190	24, 318	7. 5	182, 196	614, 117	8. 7	25. 25	3. 37	23. 6
Wisconsin, Illinois, Indiana, and Kentucky	316	241	76, 241	6. 9	524, 729	2, 416, 083	16. 5	31. 69	4. 60	73. 7
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	670	227	152, 189	7 7	1, 166, 852	4, 170, 731	4. 1	27. 40	3. 57	100. 0
Eastern Missouri, Iowa, Minnesota, and South Dakota	392	208	81, 469	7. 7	628, 910	2, 835, 830	. 5	34. 81	4. 51	91. 0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	281	231	65, 003	7 7	500, 275	1, 902, 639	3. 3	29 27	3 80	78. 3
Texas	179	231	41, 298	7. 3	303, 513	1, 739, 666	(2)	42. 12	5. 73	86. 7
Colorado, Montana, Utah, Wyoming, and Idaho	84	235	19, 773	6. 7	131, 655	800, 346	. 4	40 48	6. 08	81. 5
California	347	263	91, 144	7. 6	694, 507	4, 025, 462	2. 2	44. 17	5. 80	97. 5
Oregon and Washington	232	233	53, 978	8. 0	431, 049	1, 619, 069	1 1	29. 99	3 76	100. 0
	4, 433	234	1, 037, 183	7. 6	7, 904, 793	31, 952, 378	3. 9	30. 81	4. 04	85. 3
STATE										
Alabama	223	211	47, 066	7 9	370, 027	1, 521, 152	------	32. 32	4. 11	100. 0
California	347	263	91, 144	7. 6	694, 507	4, 025, 462	2. 2	44 17	5. 80	97. 5
Illinois	166	233	38, 746	6. 8	264, 903	1, 588, 946	19. 1	41. 01	6. 00	100. 0
Iowa	196	216	42, 345	8. 1	342, 763	1, 406, 181	(2)	33 21	4. 10	100. 0
Kansas	129	234	30, 147	7 9	238, 910	846, 398	6. 7	28. 08	3. 54	79. 9
Michigan	128	190	24, 318	7 5	182, 196	614, 117	8. 7	25. 25	3. 37	23. 6
Missouri	212	204	43, 200	7. 4	320, 772	1, 470, 705	. 4	34. 04	4. 58	100. 0
New York	219	228	49, 953	7 6	382, 131	1, 789, 022	6 2	35. 81	4. 68	100. 0
Ohio	240	222	53, 389	7. 9	422, 993	1, 548, 275	6. 4	29. 00	3. 66	85. 1
Pennsylvania	920	236	217, 069	7 8	1, 689, 999	6, 678, 696	2. 1	30 77	3. 95	88. 0
Tennessee	181	234	42, 321	8. 3	350, 528	1, 013, 871	10. 1	23. 96	2. 89	100. 0
Texas	179	231	41, 298	7. 3	303, 513	1, 739, 666	(2)	42. 12	5. 73	86. 7
Other States[3]	1, 293	245	316, 187	7 4	2, 341, 551	7, 709, 887	3. 5	24. 38	3. 29	81. 6
	4, 433	234	1, 037, 183	7. 6	7, 904, 793	31, 952, 378	3. 9	30 81	4. 04	85 3

See footnotes at end of table.

Quarry and crusher employees in the portland-cement industry, material (quarry rock and overburden) handled at quarries included in study, and average output of material per man in the United States, 1939–40, by districts and by States (excluding Puerto Rico)—Continued

District and State	Employment—quarry and crusher only: Average number of men	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per man per day	Man-hours: Total	Material handled—quarry rock and overburden: Short tons	Percent of overburden included	Average per man (short tons): Per shift	Average per man (short tons): Per hour	Percent of industry represented [1]
1940										
DISTRICT										
Eastern Pennsylvania, New Jersey, and Maryland	827	255	210, 485	7 6	1, 610, 017	6, 662, 943	2. 6	31. 66	4. 14	85. 0
New York and Maine	269	232	62, 389	7. 8	485, 967	2, 364, 828	5 2	37. 90	4. 87	100. 0
Ohio, western Pennsylvania, and West Virginia	743	257	190, 584	7 8	1, 481, 425	4, 173, 511	3. 9	21. 90	2. 82	74. 0
Michigan	160	247	39, 546	7. 4	292, 399	1, 073, 467	3. 9	27. 14	3. 67	58. 7
Wisconsin, Illinois, Indiana, and Kentucky	314	254	79, 669	6 7	534, 718	1, 933, 608	3. 6	24. 27	3. 62	57. 0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	658	243	159, 694	7 8	1, 246, 363	4, 375, 004	3. 2	27. 40	3. 51	94. 0
Eastern Missouri, Iowa, Minnesota, and South Dakota	376	222	83, 307	7 5	625, 410	2, 909, 406	(²)	34. 92	4. 65	93. 0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	295	222	65, 370	7 9	517, 761	1, 929, 348	3 8	29 51	3. 73	78. 0
Texas	139	211	29, 311	8 0	233, 191	1, 653, 628		56. 42	7. 09	91. 0
Colorado, Montana, Utah, Wyoming, and Idaho	78	227	17, 715	7 0	123, 658	942, 410	8	53 20	7. 62	100. 0
California	330	274	90, 270	7 6	683, 485	4, 777, 911	1 2	52 93	6. 99	81. 8
Oregon and Washington	205	208	42, 541	7 9	336, 710	1, 008, 436	3 1	23 71	2. 99	80. 5
	4, 394	244	1, 070, 881	7 6	8, 171, 104	33, 804, 500	2. 6	31 57	4. 14	82. 6
STATE										
Alabama	220	208	45, 817	7. 8	356, 349	1, 270, 040	(²)	27. 72	3. 56	82. 7
California	330	274	90, 270	7. 6	683, 485	4, 777, 911	1. 2	52 93	6. 99	81. 8
Illinois	143	240	34, 346	6. 6	226, 230	1, 354, 844	2 2	39. 45	5 99	100. 0
Iowa	185	223	41, 325	7. 8	321, 630	1, 412, 081	(²)	34 17	4. 39	100. 0
Kansas	125	206	25, 797	8 6	221, 508	817, 973	9 0	31 71	3 69	76. 9
Michigan	160	247	39, 546	7 4	292, 399	1, 073, 467	3 9	27. 14	3. 67	58. 7
Missouri	208	221	45, 955	7 3	337, 765	1, 552, 665	(²)	33 79	4 60	100. 0
New York	250	237	59, 290	7 8	461, 183	2, 252, 543	5 4	37. 99	4. 88	100. 0
Ohio	259	247	64, 057	7. 7	495, 844	1, 856, 079	8 7	28 98	3. 74	81. 9
Pennsylvania	916	245	224, 281	7 7	1, 725, 870	6, 628, 773	2. 2	29. 56	3. 84	77. 6
Tennessee	180	252	45, 397	8 1	368, 940	1, 113, 720	5	24 53	3. 02	100. 0
Texas	139	211	29, 311	8 0	233, 191	1, 653, 628		56 42	7. 09	91. 0
Other States [3]	1, 279	254	325, 489	7 5	2, 446, 710	8, 040, 776	3 0	24. 70	3. 29	74. 4
	4, 394	244	1, 070, 881	7. 6	8, 171, 104	33, 804, 500	2 6	31. 57	4 14	82. 6

[1] Calculated for each year by dividing quantity of finished cement produced at mills included in study by total production.
[2] Less than 0.1 percent.
[3] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

FOREIGN TRADE [2]

IMPORTS

The figures in the following table cover imports of hydraulic cements of all kinds. The values assigned represent those in the markets of the foreign countries from which the materials are exported, including the cost of containers or coverings. The second table shows imports by country of origin.

Hydraulic cement imported for consumption in the United States, 1937–41

Year	Barrels	Value	Year	Barrels	Value
1937	1,803,932	$1,392,633	1940	538,060	$506,191
1938	1,727,411	1,436,730	1941 (Jan.-Sept.)	43,110	57,914
1939	1,913,853	1,860,543			

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1940–41, by countries [1]

Country	1940		1941 (Jan.-Sept.)	
	Barrels	Value	Barrels	Value
Belgium	325,937	$285,193		
Canada	2,058	4,755	417	$760
Denmark	81,848	81,635		
Italy	581	2,561		
Japan	23,364	25,241	14,367	16,078
Mexico	296	308		
Netherlands	9,000	7,070		
Norway	3,000	3,744		
United Kingdom	71,596	72,431	28,326	41,076
Yugoslavia	17,939	14,900		
	535,619	497,838	43,110	57,914

[1] Excludes "White, nonstaining, and other special cements."

EXPORTS

Although the United States is the major cement-producing country of the world, its export trade as indicated in the following table is small. The value of exports is the actual cost at United States ports, as indicated by the shippers on the export declarations.

Hydraulic cement exported from the United States, 1937–41

Year	Barrels	Value	Percent of total shipments from mills
1937	378,554	$1,044,161	0.3
1938	558,226	1,294,883	.5
1939	1,146,339	2,352,693	.9
1940	1,667,595	3,294,118	1.3
1941 (Jan.-Sept.)	1,757,172	3,793,511	1.0

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

STONE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

GENERAL CONDITIONS

Sales of crushed and dimension stone combined continued their upward course, attaining an all-time record of 183,107,960 short tons in 1941 and exceeding sales of 1940 by 19 percent. The total value of sales was also the highest on record and topped 1940 by 22 percent. The dimension-stone industry, however, was less active than in 1940 because much of the construction during 1941 was of the war emergency type that requires relatively little building stone. Sales of dimension stone (exclusive of slate) were 8 percent lower in quantity and 0.1 percent lower in value. The crushed-stone industry, on the other hand, gained 19 percent in quantity and 25 percent in value of output in 1941.

The present chapter follows the general plan inaugurated in 1938, whereby the data on dimension stone are separated from those on crushed stone, except in the introductory general tables.

The tables of this report give the quantities sold or used by producers and the values f. o. b. quarries and mills insofar as these figures are obtainable. Stone quarried and used by producers is considered as sold and is included in the statistics of sales. The data, however, do not include stone made into abrasives (such as grindstones) or that used in making lime and cement. These materials are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following tables show the total sales of stone by kinds, uses, and States.

Stone sold or used by producers in the United States, 1937–41, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	9,265,830	$20,192,882	13,581,460	$12,508,276	207,760	$5,456,191	94,577,270	$90,901,877
1938	10,432,980	20,915,609	13,908,790	12,280,016	219,390	5,248,290	81,679,690	82,286,555
1939	12,041,360	22,495,983	16,091,250	14,164,016	228,080	6,688,662	100,846,090	94,817,481
1940	10,880,580	21,621,943	15,715,890	15,185,652	239,730	5,196,124	112,658,060	103,007,305
1941	14,298,750	24,968,489	17,936,950	18,641,852	176,460	4,785,710	133,163,600	127,585,118

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	5,072,660	$7,516,136	10,438,260	$9,637,766	133,143,240	$146,213,128
1938	6,314,430	8,066,200	12,283,660	10,458,376	124,838,940	139,255,046
1939	8,853,680	11,745,631	9,386,670	8,549,742	147,447,130	158,461,515
1940	6,498,960	8,513,654	7,739,820	6,519,437	153,733,040	160,044,115
1941	7,592,820	10,768,748	9,939,380	8,587,509	183,107,960	195,337,426

[1] Includes mica schist, conglomerate, argillite, various light-color volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any main group.

Stone sold or used by producers in the United States, 1940–41, by uses

Use	1940		1941	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction ....short tons	299,090	$1,272,588	389,160	$1,706,591
Cut stone, slabs, and mill blocks ....cubic feet	7,012,610	10,228,111	5,596,240	8,111,376
Approximate equivalent in short tons	536,700		426,850	
Rubble ....short tons	916,290	976,872	729,490	870,043
Monumental stone ....cubic feet	2,378,820	7,378,016	2,882,310	9,110,846
Approximate equivalent in short tons	196,250		237,440	
Paving blocks ....number	1,868,790	240,070	[1] 2,384,110	[1] 255,276
Approximate equivalent in short tons	18,650		[1] 20,850	
Curbing ....cubic feet	888,740	908,204	[1] 820,470	[1] 896,209
Approximate equivalent in short tons	71,450		[1] 66,240	
Flagging ....cubic feet	884,400	413,049	990,900	445,493
Approximate equivalent in short tons	68,300		76,950	
Total dimension stone (quantities approximate, in short tons)	2,106,730	21,416,910	1,946,980	21,395,834
Crushed and broken stone:				
Riprap ....short tons	5,264,100	5,414,038	5,152,640	5,226,623
Crushed stone ....do	100,268,390	91,563,088	120,963,910	114,522,259
Furnace flux (limestone and marble) ....do	22,872,050	15,754,692	27,436,440	20,069,296
Refractory stone [2] ....do	1,740,420	2,329,200	2,254,120	3,279,104
Agricultural (limestone) ....do	8,724,160	9,910,373	11,909,640	14,395,831
Other uses [3] ....do	12,757,190	13,655,814	13,444,230	16,448,479
Total crushed and broken stone ....do	151,626,310	138,627,205	181,160,980	173,941,592
Grand total (quantities approximate, in short tons)	153,733,040	160,044,115	183,107,960	195,337,426

[1] To avoid disclosing confidential information, sandstone paving blocks in 1941 are included under "Curbing."

[2] Ganister (sandstone), mica schist, soapstone, and dolomite.

[3] Includes roofing granules as follows—1940: 187,086 tons, $753,818; 1941: 177,439 tons, $715,068. Slate granules used for roofing were produced, as follows—1940: 230,440 tons, $2,009,151; 1941: 323,740 tons, $2,708,246.

Stone sold or used by noncommercial producers in the United States in 1941, by uses

[Included in total production]

Use	Short tons	Value	Use	Short tons	Value
Dimension stone:			Crushed and broken stone:		
Building stone	29,410	$121,438	Riprap	1,627,780	$1,241,785
Rubble	10,040	17,389	Crushed stone	34,603,790	35,898,874
Total dimension stone	39,450	138,827	Agricultural (limestone)	528,840	529,573
			Other uses	1,255,510	895,413
			Total crushed and broken	38,015,920	38,565,645
			Grand total	38,055,370	38,704,472

Stone sold or used by producers in the United States, 1940–41, by States

State	1940		1941	
	Short tons (approximate)	Value	Short tons (approximate)	Value
Alabama	2,496,480	$3,048,043	2,804,740	$3,745,651
Alaska	(1)	(1)		
Arizona	1,149,000	1,043,101	455,900	340,872
Arkansas	1,222,690	1,152,328	[2] 1,788,470	[2] 1,763,196
California	6,340,080	5,048,242	[2] 9,139,390	[2] 7,535,017
Colorado	1,089,650	1,067,788	1,104,820	1,073,400
Connecticut	1,915,990	1,918,132	[2] 2,244,900	[2] 2,435,841
Delaware	114,690	152,313	109,850	147,212
District of Columbia	(1)	(1)		
Florida	[2] 2,880,540	[2] 2,750,017	[2] 4,065,450	[2] 3,852,539
Georgia	2,507,600	5,034,288	2,808,790	5,809,755
Hawaii	[2] 705,470	[2] 1,140,769	[2] 1,330,170	[2] 2,149,535
Idaho	967,900	809,797	767,750	644,006
Illinois	[2] 9,209,170	[2] 7,556,497	[2] 11,856,340	[2] 10,706,996
Indiana	[2] 4,498,490	[2] 5,822,006	5,257,530	6,742,744
Iowa	4,013,740	3,832,070	5,790,920	5,657,585
Kansas	2,880,930	3,672,644	2,727,290	3,171,598
Kentucky	4,620,750	4,207,875	[2] 5,779,800	[2] 5,177,170
Louisiana	(1)	(1)	(1)	(1)
Maine	[2] 245,580	[2] 1,876,198	324,060	1,295,180
Maryland	1,109,960	1,395,373	1,604,430	2,218,478
Massachusetts	2,176,340	3,819,708	2,602,120	4,547,808
Michigan	13,527,170	6 891,433	15,161,820	8,349,607
Minnesota	1,119,230	1,987,822	1,002,190	1,811,805
Mississippi	[2] 210	[2] 410	[2] 500	[2] 750
Missouri	6,085,790	6,176,867	6,501,460	7,048,207
Montana	829,600	813,286	455,680	336,632
Nebraska	832,890	906,563	[2] 328,690	[2] 660,573
Nevada	171,670	189,143	183,170	226,827
New Hampshire	[2] 51,250	[2] 409,616	[2] 167,270	[2] 373,157
New Jersey	2,705,170	2,888,339	3,206,050	3,782,036
New Mexico	362,020	223,680	118,180	111,709
New York	9,782,120	10,398,401	10,406,740	10,806,450
North Carolina	3,031,300	4,850,277	3,820,200	4,806,623
North Dakota	(1)	(1)	18,590	19,713
Ohio	[2] 11,915,520	[2] 10,234,221	[2] 13,842,870	[2] 12,469,498
Oklahoma	1,311,640	1,217,525	1,876,570	1,945,753
Oregon	[2] 2,757,820	[2] 2,234,928	2,836,390	2,436,783
Pennsylvania	[2] 19,277,690	[2] 19,855,478	[2] 23,506,540	[2] 25,013,400
Puerto Rico	406,160	271,022	675,970	968,448
Rhode Island	[2] 201,380	[2] 511,620	212,580	493,715
South Carolina	[2] 1,233,610	[2] 1,570,689	2,055,090	2,574,797
South Dakota	255,600	878,866	[2] 401,550	[2] 1,189,564
Tennessee	5,604,170	6,674,710	7,896,970	9,157,673
Texas	2,737,690	2,581,358	3,497,720	2,908,364
Utah	1,024,660	693,127	408,140	340,551
Vermont	[2] 135,680	[2] 3,681,752	185,840	4,190,112
Virginia	6,800,640	6,959,136	9,195,450	9,586,541
Washington	2,347,190	1,941,820	2,148,970	1,757,873
West Virginia	[2] 3,719,950	[2] 3,818,788	[2] 4,547,200	[2] 5,988,840
Wisconsin	4,330,360	5,030,263	4,376,720	5,666,120
Wyoming	405,140	375,463	838,050	737,455
Undistributed	624,670	430,323	672,080	563,267
	153,733,040	160,044,115	183,107,960	195,337,426

[1] Included under "Undistributed."

[2] To avoid disclosing confidential information, certain State totals are incomplete, the figures not included being combined under "Undistributed."

DIMENSION STONE

The term "dimension stone" is applied to blocks or slabs of natural stone, most of which are cut to definite shapes and sizes. These products are quite distinct from crushed, broken, and pulverized stone, which comprises irregular fragments or grains sized chiefly by mechanical screening or air separation. Crushed and broken stone is covered in a later section of this chapter.

Dimension-stone producers may be divided into three main groups upon the basis of plant operation. The first group quarries stone and sells it as rough blocks or slabs; the second quarries stone and also manufactures it into finished products; and the third buys sawed slabs or rough blocks of stone and manufactures them into finished products but does not operate quarries. The Bureau of Mines statistical canvass covers the first and second groups, but as the third group comprises manufacturers rather than quarrymen it is canvassed by the Bureau of the Census. Bureau of Mines statistics are compiled from reports of quantities and values of original sales; hence they include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone in 1941 declined 6 percent in quantity but gained 4 percent in value compared with 1940. These figures include slate, but details of the slate industry are given in the separate chapter on Slate. Dimension marble, limestone, and basalt declined substantially in both quantity and value, but granite, sandstone, and miscellaneous stone registered gains.

The following table of salient statistics for dimension stone includes figures for 1940 and 1941, as well as the percentage change from 1940 for each type of stone by principal products.

Dimension stone sold or used by producers in the United States, 1940–41, by kinds and uses

Kind and use	1940	1941 Total	1941 Percent of change
Granite:			
Building stone:			
Rough construction ... short tons	89,040	167,440	+88.1
Value	$245,385	$298,253	+21.5
Average per ton	$2.76	$1.78	−35.5
Cut stone, slabs, and mill blocks ... cubic feet	1,104,590	736,730	−33.3
Value	$2,847,082	$1,853,203	−34.9
Average per cubic foot	$2.58	$2.52	−2.3
Rubble ... short tons	239,560	277,950	+16.0
Value	$288,636	$349,739	+21.2
Monumental stone ... cubic feet	2,108,950	2,576,550	+22.2
Value	$5,906,942	$7,489,197	+26.8
Average per cubic foot	$2.80	$2.91	+3.9
Paving blocks ... number	1,813,130	2,384,110	+31.5
Value	$236,330	$255,276	+8.0
Curbing ... cubic feet	569,290	528,420	−7.2
Value	$563,849	$585,808	+3.9
Total:			
Quantity ... approximate short tons	658,250	782,120	+18.8
Value	$10,088,224	$10,831,476	+7.4
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction ... short tons	15,680	10,170	−35.1
Value	$17,548	$17,182	−2.1
Average per ton	$1.12	$1.69	+50.9
Rubble ... short tons	6,120	130	−97.9
Value	$3,089	$550	−82.2

Dimension stone sold or used by producers in the United States, 1940–41, by kinds and uses—Continued

Kind and use	1940	1941 Total	1941 Percent of change
Basalt and related rocks—Continued.			
Total:			
Quantity short tons	21,800	10,300	−52.8
Value	$20,637	$17,732	−14.1
Marble:			
Building stone (cut stone, slabs, and mill blocks) cubic feet	782,600	511,810	−34.6
Value	$3,324,029	$2,748,572	−17.3
Average per cubic foot	$4.25	$5.37	+26.4
Monumental stone cubic feet	269,870	305,760	+13.3
Value	$1,471,074	$1,621,649	+10.2
Average per cubic foot	$5.45	$5.30	−2.8
Total:			
Quantity approximate short tons	89,040	69,300	−22.2
Value	$4,795,103	$4,370,221	−8.9
Limestone:			
Building stone:			
Rough construction short tons	103,470	106,290	+2.7
Value	$174,148	$367,995	+111.3
Average per ton	$1.68	$3.46	+106.0
Cut stone, slabs, and mill blocks cubic feet	4,636,950	3,834,860	−17.3
Value	$3,425,411	$2,909,728	−15.1
Average per cubic foot	$0.74	$0.76	+2.7
Rubble short tons	616,250	405,220	−34.2
Value	$582,257	$439,479	−24.5
Flagging cubic feet	236,530	210,290	−11.1
Value	$78,149	$62,794	−19.6
Total:			
Quantity approximate short tons	1,082,130	813,620	−24.8
Value	$4,259,965	$3,779,996	−11.3
Sandstone:			
Building stone:			
Rough construction short tons	33,470	31,850	−4.8
Value	$80,750	$106,426	+31.8
Average per ton	$2.41	$3.34	+38.6
Cut stone, slabs, and mill blocks cubic feet	488,470	512,840	+5.0
Value	$631,589	$599,873	−5.0
Average per cubic foot	$1.29	$1.17	−9.3
Rubble short tons	31,130	33,990	+9.2
Value	$47,201	$46,253	−2.0
Paving blocks number	55,660	(1)	(1)
Value	$3,740	(1)	(1)
Curbing cubic feet	319,450	[1] 292,050	(1)
Value	$344,355	[1] $310,401	(1)
Flagging cubic feet	614,260	743,680	+21.1
Value	$318,569	$366,426	+15.0
Total:			
Quantity approximate short tons	172,130	183,040	+6.3
Value	$1,426,204	$1,429,379	+.2
Miscellaneous stone:[2]			
Building stone cubic feet	680,690	870,800	+27.9
Value	$754,757	$916,735	+21.5
Average per cubic foot	$1.11	$1.05	−5.4
Rubble short tons	23,230	12,200	−47.5
Value	$55,689	$34,022	−38.9
Flagging cubic feet	33,610	36,930	+9.9
Value	$16,331	$16,273	−.4
Total:			
Quantity approximate short tons	83,380	88,600	+6.3
Value	$826,777	$967,030	+17.0
Total dimension stone, excluding slate:			
Quantity approximate short tons	2,106,730	1,946,980	−7.6
Value	$21,416,910	$21,395,834	−.1
Slate as dimension stone[3] approximate short tons	154,450	180,990	+17.2
Value	$3,436,368	$4,409,834	+28.3
Total dimension stone, including slate:			
Quantity approximate short tons	2,261,180	2,127,970	−5.9
Value	$24,853,278	$25,805,668	+3.8

[1] To avoid disclosing confidential information, paving blocks in 1941 are included under "Curbing."
[2] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[3] Details of production, by uses, are given in the chapter on Slate in this volume.

BUILDING STONE

The largest use of dimension stone is for building. The following table gives the quantity and value of each kind of stone used for construction in 1941.

Building stone sold or used by producers in the United States in 1941, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	2,034,920	$298,253	433,350	$514,585
Basalt	108,510	17,182		
Marble			98,800	239,376
Limestone	1,319,870	367,995	1,651,910	666,323
Sandstone	402,520	106,426	256,740	202,165
Miscellaneous	870,800	916,735		
	4,736,620	1,706,591	2,440,800	1,622,449

Kind	Finished				Total	
	Sawed [1]		Cut [1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	83,580	$304,338	219,800	$1,034,280	2,771,650	$2,151,456
Basalt					108,510	17,182
Marble	113,920	293,561	299,090	2,215,635	511,810	2,748,572
Limestone	1,124,520	632,108	1,058,430	1,611,297	5,154,730	3,277,723
Sandstone	212,450	252,612	43,650	145,096	915,360	706,299
Miscellaneous					870,800	916,735
	1,534,470	1,482,619	1,620,970	5,006,308	10,332,860	9,817,967

[1] For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

GRANITE

Sales of block granite increased 19 percent in quantity and 7 percent in value in 1941 compared with 1940. Sales of rough architectural and dressed building stone declined greatly; but the cruder forms of building stone—namely, rubble and rough construction stone—made important gains. Net losses in the construction field were more than compensated by substantial gains in sales of both rough and dressed monumental stone. The value per cubic foot of dressed building stone increased from $4.31 in 1940 to $4.41 in 1941, and the value of dressed monumental stone increased from $6.04 to $6.35. The number of paving blocks sold in 1941 increased 31 percent over the number in 1940, but the quantity of curbing sold declined 7 percent. The unit value of paving blocks receded, but that of curbing advanced.

Granite (dimension stone) sold or used by producers in the United States in 1941, by States and uses

State	Active plants	Building								Monumental				Paving blocks		Curbing		Total	
		Rough				Dressed		Rubble		Rough		Dressed							
		Construction		Architectural															
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Number	Value	Cubic feet	Value	Short tons (approximate)	Value
California	13	5,630	$5,582	2,500	$1,350	630	$3,487	5,980	$11,409	14,460	$29,104	21,930	$143,644	------	------	1,490	$1,880	14,980	$196,456
Colorado	8	(1)	(1)	------	------	(1)	(1)	------	------	2,380	5,672	3,520	18,432	------	------	------	------	570	25,087
Connecticut	6	5,620	13,879	6,120	6,960	(1)	(1)	(1)	(1)	2,870	9,019	(1)	(1)	(1)	(1)	(1)	(1)	10,580	85,669
Georgia	18	2,900	5,600	1,500	7,530	25,890	116,441	8,550	7,091	570,770	712,378	169,970	699,702	10,000	$600	37,870	61,943	78,440	1,611,285
Maine	13	4,120	23,815	74,100	59,356	124,560	538,703	(1)	(1)	9,500	6,870	3,260	14,555	(1)	(1)	8,600	8,340	35,070	818,535
Maryland	5	16,300	66,000	(1)	(1)	------	------	69,000	119,500	------	------	------	------	------	------	(1)	(1)	88,990	207,881
Massachusetts	17	1,010	5,995	183,300	321,169	64,940	277,043	15,530	28,786	28,880	67,459	25,670	178,567	39,690	3,413	346,190	309,755	70,440	1,192,187
Minnesota	23	------	------	71,070	53,920	12,400	45,870	------	------	255,620	252,987	48,390	281,863	------	------	------	------	32,120	634,640
Missouri	4	1,480	4,375	------	------	------	------	------	------	11,120	22,230	250	1,743	------	------	------	------	2,430	28,348
Montana	7	------	------	(1)	(1)	------	------	------	------	1,670	2,486	(1)	(1)	------	------	------	------	190	6,856
New Hampshire	9	4,520	8,412	8,190	8,637	16,130	80,500	(1)	(1)	4,380	7,370	7,460	40,200	(1)	(1)	(1)	(1)	10,800	156,016
New Jersey	1	(1)	(1)	------	------	------	------	(1)	(1)	------	------	------	------	------	------	------	------	(1)	(1)
New York	2	(1)	(1)	(1)	(1)	------	------	(1)	(1)	------	------	------	------	------	------	------	------	(1)	(1)
North Carolina	6	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	20,730	33,100	(1)	(1)	483,470	33,551	(1)	(1)	16,170	436,342
Oklahoma	8	------	------	(1)	(1)	------	------	------	------	31,920	71,021	16,470	153,915	------	------	(1)	(1)	4,000	225,314
Pennsylvania	13	20,500	47,712	(1)	(1)	------	------	118,690	127,024	(1)	(1)	36,000	169,472	(1)	(1)	4,900	2,516	143,740	367,800
Rhode Island	3	------	------	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)	------	------	------	------	(1)	(1)
South Carolina	4	------	------	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)	------	------	(1)	(1)	(1)	(1)
South Dakota	7	(1)	(1)	25,200	11,419	(1)	(1)	(1)	(1)	82,170	69,874	95,640	633,649	------	------	------	------	86,320	809,362
Texas	7	58,230	35,264	(1)	(1)	(1)	(1)	------	------	14,380	26,930	13,840	109,803	------	------	------	------	61,550	227,621
Vermont	8	------	------	(1)	(1)	------	------	------	------	781,280	2,455,652	(1)	(1)	------	------	------	------	65,950	2,4/2,375
Virginia	2	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)	------	------	(1)	(1)	------	------	(1)	(1)
Washington	4	------	------	(1)	(1)	------	------	(1)	(1)	(1)	(1)	(1)	(1)	------	------	------	------	(1)	(1)
Wisconsin	14	------	------	11,490	10,568	2,000	8,000	------	------	6,920	12,303	58,030	715,807	327,590	45,172	------	------	9,730	791,850
Undistributed	------	47,130	81,619	49,880	33,676	56,830	268,574	60,200	55,929	221,630	428,156	15,440	113,234	1,523,360	172,540	129,370	201,374	50,050	537,852
	202	167,440	298,253	433,350	514,585	303,380	1,338,618	277,950	349,739	2,060,680	4,214,611	515,870	3,274,586	2,384,110	255,276	528,420	585,808	782,120	10,831,476
Average unit value	------	------	$1.78	------	$1.19	------	$4.41	------	$1.26	------	$2.05	------	$6.35	------	$0.11	------	$1.11	------	$13.85
Short tons (approximate)	------	(2)	------	35,750	------	25,080	------	------	------	168,890	------	42,580	------	20,850	------	43,580	------	------	------

[1] Included under "Undistributed."
[2] 2,034,920 ubic feet (approximate).

The following tables show sales of monumental granite in the Quincy (Mass.) and Barre (Vt.) centers.

Monumental granite sold by quarrymen at Quincy, Mass., 1937–41 [1]

Year	Active plants	Cubic feet	Value	Year	Active plants	Cubic feet	Value
1937	3	36,020	$80,248	1940	3	24,540	$60,139
1938	3	33,360	73,832	1941	3	26,670	65,062
1939	3	25,620	61,955				

[1] Quincy granite is sold also for construction, curbing, rubble, riprap, and crushed stone.

Monumental granite sold by quarrymen in the Barre district, Vermont, 1937–41 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1937	847,740	$2,390,377	1940	601,190	$2,039,960
1938	605,660	1,849,607	1941	764,280	2,431,152
1939	684,310	2,029,801			

[1] Barre granite is sold also for construction and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1939–41 [1]

	1939	1940	1941
Total quarry output, rough stock......cubic feet..	614,256	548,412	668,544
Shipped out of Barre district in rough......do...	122,852	109,682	133,709
Manufactured in Barre district......do...	491,404	438,730	534,835
Light stock consumed in district......do...	307,128	274,206	334,272
Dark stock consumed in district......do...	184,276	164,524	200,563
Number of cutters in district	1,550	1,295	1,295
Average daily wage	$8.50	$8.50	$9.00
Average number of days worked	220	220	230
Total pay roll for year	$2,898,500	$2,421,650	$3,729,600
Estimated overhead	1,449,250	1,210,825	1,864,800
Estimated value of light stock	1,247,714	1,199,651	1,398,605
Estimated value of dark stock	990,494	874,033	1,097,367
Estimated polishing cost	388,039	346,980	422,988
Output from saws	129,546	115,660	140,996
Total value of granite	7,104,143	6,168,799	8,654,356

[1] Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen.

BASALT AND RELATED ROCKS (TRAP ROCK)

Because of its dark color, basalt is not used extensively for building. The tonnage sold in 1941 was less than one-half that in 1940, but the value per ton increased from 95 cents to $1.72. In 1939 considerable quantities were used for rubble, but this use declined greatly in 1940 and almost disappeared in 1941. Some of these dark rocks are used for memorials, but such stones are classed commercially as black granites and are therefore included with the figures for monumental granite.

Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1941, by States and uses

State	Active plants	Building stone				Total	
		Rough construction		Rubble			
		Short tons	Value	Short tons	Value	Short tons	Value
California	1			30	$400	30	$400
Connecticut	3	3,420	$3,325			3,420	3,325
New Jersey	1	110	110			110	110
Oregon	1	2,260	9,248			2,260	9,248
Pennsylvania	3	4,380	4,499	100	150	4,480	4,649
	9	[1] 10,170	17,182	130	550	10,300	17,732
Average unit value			$1.69		$4 23		$1.72

[1] 108,510 cubic feet (approximate).

MARBLE

Sales of dimension marble in 1941 declined 22 percent in quantity and 9 percent in value compared with 1940. Large declines in sales of building marble were compensated to some extent by general increases in sales of monumental marble, which depend primarily on buying power. Decreases in total quantities sold were shared by all the leading States except Georgia, although the value of sales was higher in Vermont and Utah than in 1940.

Marble (dimension stone) sold by producers in the United States, 1940–41, by uses

Use	1940		1941	
	Cubic feet	Value	Cubic feet	Value
Building stone:				
Rough:				
Exterior	65,070	$159,337	31,300	$63,647
Interior [1]	111,610	270,715	67,500	175,729
Finished				
Exterior	313,300	1,214,887	153,360	731,479
Interior	292,620	1,679,090	259,650	1,777,717
Total exterior	378,370	1,374,224	184,660	795,126
Total interior	404,230	1,949,805	327,150	1,953,446
Total building stone	782,600	3,324,029	511,810	2,748,572
Monumental stone.				
Rough	56,190	64,122	61,790	68,165
Finished	213,680	1,406,952	243,970	1,553,484
Total monumental stone	269,870	1,471,074	305,760	1,621,649
Total building and monumental	1,052,470	4,795,103	817,570	4,370,221
Approximate short tons	89,040		69,300	

[1] Includes onyx for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

Marble (dimension stone) sold by producers in the United States in 1941, by States and uses

State	Active plants	Building [1]		Monumental		Total		
						Quantity		
		Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value
Alabama	2	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Arkansas	3	(2)	(2)	(2)	(2)	11,000	940	$15,000
California	3	2,130	$11,393			2,130	180	11,393
Colorado	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Georgia	1	51,520	294,341	160,650	$717,573	212,170	18,030	1,011,914
Maryland	1	2,980	23,947			2,980	250	23,947
Massachusetts	1	7,550	14,975	7,990	57,566	15,540	1,320	72,541
Minnesota	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Missouri	4	63,180	256,094	8,680	19,868	71,860	5,930	275,962
New York	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
North Carolina	1			(2)	(2)	(2)	(2)	(2)
Pennsylvania	1	(2)	(2)			(2)	(2)	(2)
Tennessee	7	168,430	879,980	11,670	68,414	180,100	15,330	948,394
Utah [3]	1	960	9,600			960	80	9,600
Vermont	6	124,690	821,099	96,060	591,072	220,750	18,760	1,412,171
Virginia	2	(2)	(2)			(2)	(2)	(2)
Undistributed		90,370	437,143	20,710	167,156	100,080	8,480	589,299
	36	511,810	2,748,572	305,760	1,621,649	817,570	69,300	4,370,221
Average unit value			$5.37		$5.30			[4] $5.35
Short tons (approximate)		43,330		25,970				

[1] Includes 4,720 cubic feet of serpentine marble (verde antique) valued at $34,101, which was sold as building and ornamental stone.
[2] Included under "Undistributed."
[3] Figures represent onyx rough blocks for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.
[4] Average value per cubic foot.

LIMESTONE

Unlike granite and marble, of which substantial quantities are sold for memorial uses, block limestone is employed almost exclusively as building stone. Limestone is used in the United States more extensively than any other type of building stone, and Indiana producers supplied about 76 percent of the rough architectural and finished (sawed and cut) limestone sold in 1941. The total quantity of dimension limestone sold in 1941 was 25 percent less and its value 11 percent less than in 1940.

Rough building limestone sold made only a small gain in quantity, but the sales value was more than twice that in 1940. All other types of building limestone suffered serious declines because during a war emergency construction of buildings using stone as a major material is greatly restricted. Sales of flagging declined moderately in 1941.

Limestone (dimension stone) sold or used by producers in the United States in 1941, by States and uses

State	Active plants	Building								Flagging		Total	
		Rough				Finished (cut and sawed)		Rubble					
		Construction		Architectural									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Short tons (approximate)	Value
Alabama	3	(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)
Arizona	1	(1)	(1)									(1)	(1)
California	5	2,070	$2,363					420	$312	2,490	$1,337	2,680	$4,012
Colorado	1			4,860	$9,726							360	9,726
Florida	3					(1)	(1)			(1)	(1)	1,610	55,902
Illinois	12	3,130	15,204	25,000	7,500			1,680	2,438	2,070	779	7,110	25,921
Indiana	20			1,047,000	309,444	1,856,480	$1,745,357	(1)	(1)	(1)	(1)	217,780	2,060,616
Iowa	7	2,820	2,845					2,180	2,108	5,730	799	5,490	5,752
Kansas	10	17,610	44,691	127,130	22,933	(1)	(1)	8,420	9,004	(1)	(1)	46,780	180,282
Kentucky	8	2,990	3,560					3,710	2,774	280	95	6,720	6,429
Maryland	1							(1)	(1)			(1)	(1)
Massachusetts	1	(1)	(1)									(1)	(1)
Michigan	2	(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)
Minnesota	7	(1)	(1)	26,130	17,408	(1)	(1)	4,030	5,822	(1)	(1)	15,600	167,541
Missouri	14	(1)	(1)			(1)	(1)	44,030	64,516	5,650	2,492	46,530	73,580
Montana	1			(1)	(1)							(1)	(1)
Nebraska	1	(1)	(1)									(1)	(1)
New Mexico	1	(1)	(1)									(1)	(1)
New York	5	(1)	(1)					(1)	(1)			970	2,093
Ohio	9	12,110	21,280					(1)	(1)	(1)	(1)	20,420	28,953
Pennsylvania	19	14,620	19,911					12,150	12,702	9,880	1,479	27,590	34,092
Puerto Rico	2	(1)	(1)					(1)	(1)			(1)	(1)
Tennessee	2	(1)	(1)					(1)	(1)			(1)	(1)
Texas	5	(1)	(1)	(1)	(1)	(1)	(1)	293,790	294,891	(1)	(1)	315,320	540,670
Virginia	2	(1)	(1)					(1)	(1)			(1)	(1)
Wisconsin	17	15,890	88,707	341,830	236,247	59,140	49,231	10,180	20,804	92,430	30,403	65,610	425,392
Undistributed		35,050	169,434	79,960	63,065	267,330	448,817	24,630	24,108	91,760	25,410	33,050	159,035
	159	106,290	367,995	1,651,910	666,323	2,182,950	2,243,405	405,220	439,479	210,290	62,794	813,620	3,779,996
Average unit value			$3.46		$0.40		$1.03		$1.08		$0.30		$4.65
Short tons (approximate)		(2)		124,640		160,440				17,030			

[1] Included under "Undistributed."
[2] 1,319,870 cubic feet (approximate).

The following tables show detailed figures, by uses, for limestone produced near Bedford and Bloomington, Ind., and Carthage, Mo.

Limestone sold by producers in the Indiana oolitic-limestone district, 1937–41, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1937	2,152,560	$727,425	957,240	$633,350	1,332,330	$2,168,229
1938	2,090,110	619,602	914,180	561,767	1,147,620	2,044,216
1939	2,462,860	845,252	1,277,730	784,247	1,534,530	2,470,724
1940	1,395,910	425,990	994,370	573,368	831,900	1,125,825
1941	1,047,000	309,444	1,029,970	567,706	826,510	1,177,651

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1937	4,442,130	322,050	$3,529,004	139,250	$68,253	461,300	$3,597,257
1938	4,151,910	310,000	3,225,585	41,610	26,595	351,610	3,252,180
1939	5,275,120	383,000	4,100,223	247,680	117,200	630,680	4,217,423
1940	3,222,180	233,600	2,125,183	79,730	40,676	313,330	2,165,859
1941	2,903,480	210,500	2,054,801	135,610	98,547	346,110	2,153,348

Indiana limestone sold by mills in the district not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1937–41, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1937	168,340	$93,815	1,142,249	$1,931,488	1,310,589	$2,025,303
1938	110,670	69,896	1,136,410	1,703,254	1,247,080	1,773,150
1939	108,360	50,338	1,839,520	2,966,530	1,947,880	3,016,868
1940	272,510	182,239	1,034,100	1,629,273	1,306,610	1,811,512
1941:						
Mills not operated by quarry companies	65,310	32,382	372,690	584,891	438,000	617,273
Mills of quarry companies from stock obtained at quarries other than their own	21,380	15,120	317,560	458,883	338,940	474,003
	86,690	47,502	690,250	1,043,774	776,940	1,091,276

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1937–41, by classes

Year	Dimension stone (rough and dressed)							Other uses		Total	
	Building		Monumental		Total						
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1937	128,570	$338,040	7,530	$14,912	136,100	11,380	$352,952	95,840	$128,617	107,220	$481,569
1938	113,940	300,936	8,450	18,831	122,390	10,220	319,767	65,560	118,349	75,780	438,116
1939	180,040	448,966	8,400	18,603	188,440	15,730	467,569	60,580	94,215	76,310	561,784
1940	[1] 124,180	248,498	8,430	18,844	[1] 132,610	[1] 11,070	267,342	90,390	128,627	[1] 101,460	395,969
1941	50,000	219,361	8,680	19,868	58,680	4,900	239,229	253,030	414,770	257,930	653,999

[1] Revised figures.

SANDSTONE

Sales of dimension sandstone increased 6 percent in quantity in 1941 compared with 1940 but remained almost the same in value. Figures for sandstone used for rough construction, for rough architectural building purposes, as rubble, and for curbing show small changes from those of the corresponding classifications in 1940. Sales of sawed stone advanced, but those of cut stone declined. The largest gains were in sales of flagging. Paving-stone production, once an important branch of the industry, has declined almost to the vanishing point.

The second table following presents a 20-year history of the bluestone industry. This type of sandstone is used for building stone and for curbing and flagging. As "sidewalk stone" it has been replaced generally by concrete, but this loss of market has been compensated to some extent by enlarged demands for ornamental flagging. Sales in 1941 were 11 percent higher in quantity but 7 percent lower in value than in 1940.

Sandstone (dimension stone) sold or used by producers in the United States in 1941, by States and uses

State	Active plants	Building								Rubble		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Dressed											
						Sawed		Cut									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
California	9	2,690	$10,500							2,330	$2,816			31,370	$16,139	7,470	$29,455
Colorado	2	(1)	(1)							(1)	(1)			(1)	(1)	(1)	(1)
Connecticut	1							1,260	$7,069							100	7,069
Georgia	1													3,500	1,680	270	1,680
Indiana	1	(1)	(1)													(1)	(1)
Kansas	1									90	81			4,700	3,299	460	3,380
Maryland	7	2,850	7,043							18,760	15,304			39,680	13,914	24,780	36,261
Massachusetts	1			(1)	(1)			(1)	(1)							(1)	(1)
Michigan	1	1,100	5,500	1,250	$1,200					200	1,000					1,400	7,700
Minnesota	1	(1)	(1)													(1)	(1)
Mississippi	1	(1)	(1)													(1)	(1)
New Jersey	1	(1)	(1)							(1)	(1)					(1)	(1)
New York [2]	21	2,470	7,472	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	[3] 119,460	[3] $120,322	91,860	76,014	22,210	234,514
Ohio	9	1,030	2,397	227,820	175,854	205,570	$233,418	26,200	72,739	730	3,090	167,810	185,406	420,260	119,629	77,710	792,533
Pennsylvania [4]	18	10,700	25,122							6,290	11,602	4,780	4,673	103,910	79,564	26,030	120,961
Tennessee	3	5,880	24,304											36,220	50,684	8,710	74,988
Vermont	1									3,350	5,730					3,350	5,730
Virginia	7	870	2,934							50	50			8,910	3,653	1,630	6,637
Washington	1					(1)	(1)	(1)	(1)							(1)	(1)
West Virginia	1									(1)	(1)					(1)	(1)
Wisconsin	5			20,900	15,750			(1)	(1)	(1)	(1)			(1)	(1)	1,910	19,038
Undistributed		4,260	21,154	6,770	9,361	6,880	19,194	16,190	65,288	2,190	6,580			3,270	1,850	7,010	89,433
	93	31,850	106,426	256,740	202,165	212,450	252,612	43,650	145,096	33,990	46,253	[3] 292,050	[3] 310,401	743,680	366,426	183,040	1,429,379
Average unit value			$3.34		$0.79		$1.19		$3.32		$1.36		[3] $1.06		$0.49		$7.81
Short tons (approximate)		(5)		18,830		15,480		3,300				22,660		56,930			

[1] Included under "Undistributed."
[2] Includes 169,520 cubic feet of bluestone (approximately 14,320 short tons) valued at $172,329 sold for construction, curbing, and flagging.
[3] Includes a small quantity of paving blocks.
[4] Includes 114,670 cubic feet of bluestone (approximately 9,690 short tons) valued at $79,984 sold for construction, curbing, and flagging.
[5] 402,520 cubic feet (approximate).

Bluestone (dimension stone) sold or used in the United States, 1922–41[1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1922	722,830	$697,341	1932	185,960	$185,643
1923	618,360	747,422	1933	116,246	123,867
1924	769,240	875,734	1934	181,960	168,720
1925	987,300	910,585	1935	215,150	203,537
1926	692,640	885,597	1936	343,040	332,749
1927	815,730	1,000,217	1937	308,740	346,349
1928	891,190	1,014,843	1938	329,670	369,857
1929	670,020	773,532	1939	254,440	319,405
1930	611,240	749,703	1940	256,900	272,501
1931	356,210	427,801	1941	284,190	252,313

[1] New York and Pennsylvania are the only States that produce bluestone.

MISCELLANEOUS STONE

The following table gives data on certain types of dimension stone not included in the major groups already discussed. The principal varieties are mica schist, argillite, various light-color volcanic rocks, soapstone, and greenstone. The quantity sold in 1941 increased 6 percent and the value 17 percent over 1940.

Miscellaneous varieities of stone (dimension stone) sold or used by producers in the United States in 1941, by States and uses

State	Active plants	Building: Rough and dressed		Building: Rubble		Flagging		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
California	1	(1)	(1)	(1)	(1)			(1)	(1)
Florida	1			(1)	(1)			(1)	(1)
Georgia	2					(1)	(1)	(1)	(1)
Maryland	5	9,670	$32,476	2,100	$6,600	530	$2,640	12,300	$41,716
New York	2	(1)	(1)					(1)	(1)
Ohio	1	(1)	(1)					(1)	(1)
Pennsylvania	7	(1)	(1)	(1)	(1)			58,730	85,278
Virginia	2	(1)	(1)			(1)	(1)	(1)	(1)
Undistributed		63,740	884,259	10,100	27,422	2,460	13,633	17,570	840,036
	21	[2] 73,410	916,735	12,200	34,022	[2] 2,990	16,273	88,600	967,030
Average unit value			$12.49		$2.79		$5.44		$10.91

[1] Included under "Undistributed."
[2] Building stone (rough and dressed), approximately 870,800 cubic feet; flagging, approximately 36,930 cubic feet.

TRENDS IN USE OF DIMENSION STONE

Figure 1 shows graphically the history of production of dimension stone, by kinds, for a 26-year period. Dimension stone includes all classes of building stone, as well as memorial stone, paving blocks, curbing, and flagging. Limestone and granite are the leading varieties. All kinds of dimension stone follow essentially the same pattern throughout both lean and prosperous years.

Figure 2 traces the history of production of all building stones and of the principal variety—limestone—in their relation to nonresidential building, the class of construction using stone most extensively. Stone is a dignified, substantial, and enduring building material that is used chiefly in permanent and relatively costly structures. The necessities of war stimulate enormous building

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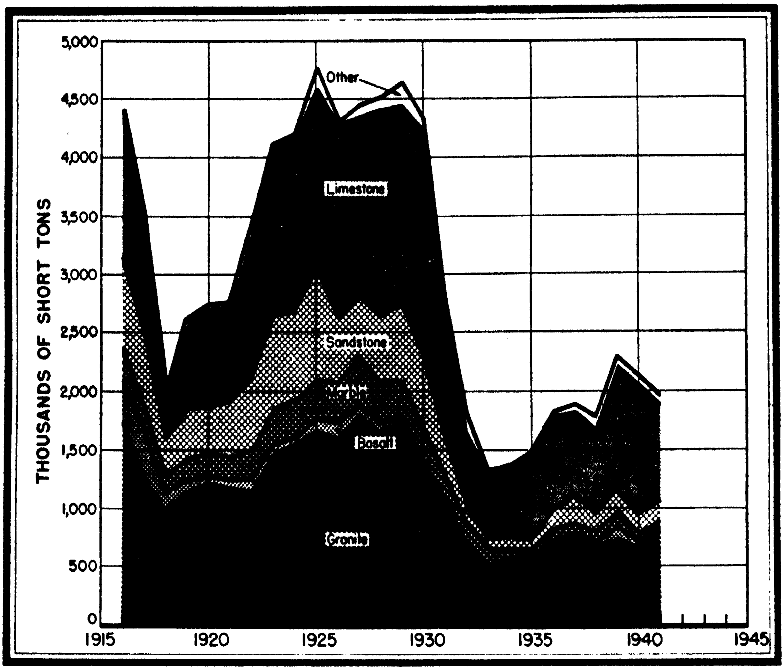

FIGURE 1.—Sales of dimension stone in the United States, by kinds, 1916–41.

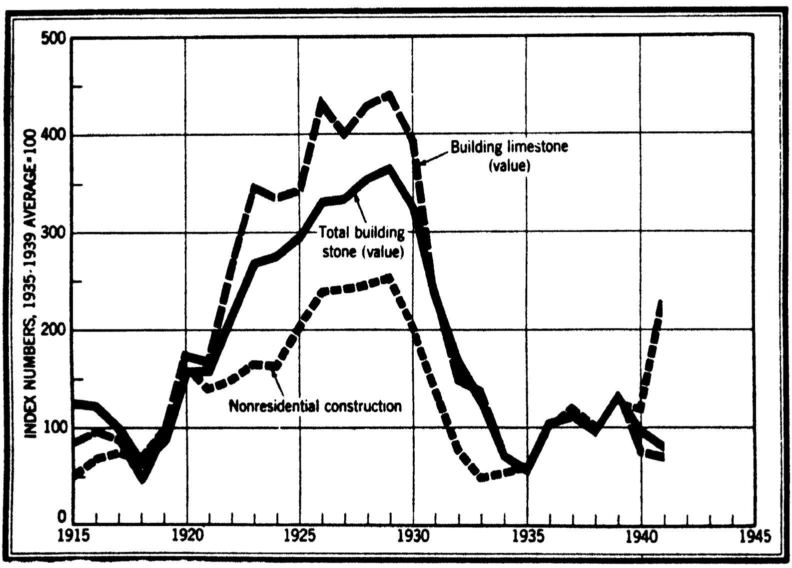

FIGURE 2.—Sales of all building stone and building limestone compared with nonresidential construction (public and private), 1915–41. Data on nonresidential building construction from Bureau of Foreign and Domestic Commerce.

programs, but the types of construction demanded for such emergencies employ only limited quantities of dimension stone. As indicated in figure 2, wars and depressions are inimical to activity in the building-stone industries which flourish during eras of peace and general prosperity. Building-stone sales fell to a low point in 1918 at the close of the First World War; but they recovered rapidly and, upon the basis of the 1935–39 averages, attained much higher levels than nonresidential building (public plus private) during the prosperous years 1926–29. Sales of stone followed closely the rapid decline in nonresidential building during the depression years that followed. Although building has recovered substantially since 1935, stone has made only moderate gains, and the Second World War has depressed activity to an exceptional extent.

NEW DEVELOPMENTS

No important new developments were reported by the dimension-stone industries during 1941. One new marble quarry was opened near Bainbridge, Pa. In general, the demands for building and memorial stone were so limited that some units of unused machinery and facilities were diverted to the manufacture of war materials.

The Bureau of Mines has issued an index to locations of stone quarries.[1] It is not a directory but indicates the kinds of stone quarried, by States and counties.

CRUSHED AND BROKEN STONE

Over 181,000,000 short tons of crushed and broken stone were sold in 1941, exclusive of that used for making cement and lime. Sales increased 19 percent in quantity and 25 percent in value compared with 1940.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1940 and 1941, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters on Asphalt and Slate.

[1] Downey, M. G., Index to Locations of Stone Quarries: Bureau of Mines Inf. Circ. 7187, 1941, 9 pp.

Crushed and broken stone sold or used by producers in the United States, 1940–41, by principal uses

Use	1940			1941		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	92,814,090	$86,331,273	$0.93	110,192,610	$106,985,808	$0.97
Railroad ballast	7,454,300	5,231,815	.70	10,771,300	7,536,451	.70
Metallurgical	22,872,050	15,754,692	.69	27,436,440	20,069,296	.73
Alkali works	4,848,490	2,017,804	.42	5,888,260	2,721,635	.46
Riprap	5,264,100	5,414,038	1.03	5,152,640	5,226,623	1.01
Agricultural	8,724,160	9,910,373	1.14	11,909,640	14,395,831	1.21
Refractory (ganister, mica schist, dolomite, soapstone)	1,740,420	2,329,200	1.34	2,254,120	3,279,104	1.45
Asphalt filler	320,220	759,399	2.37	443,480	1,050,927	2.37
Calcium carbide works	482,950	389,246	.81	468,600	343,241	.73
Sugar factories	558,560	868,786	1.56	624,450	936,874	1.50
Glass factories	300,720	475,273	1.58	385,680	578,226	1.50
Paper mills	333,800	575,814	1.73	361,830	643,124	1.78
Other uses	5,912,450	8,569,492	1.45	5,271,930	10,174,452	1.93
	151,626,310	138,627,205	.91	181,160,980	173,941,592	.96
Portland cement (including "cement rock")[1] Natural cement ("cement rock")[1]	[2] 34,041,000	([3])		42,735,000	([3])	
Lime [4]	9,774,000	([3])		12,159,000	([3])	
Total stone	[2] 195,441,000	([3])		236,055,000	([3])	
Asphaltic stone	458,665	1,949,166	4.25	654,692	2,312,227	3.53
Slate granules and flour	319,000	2,301,901	7.22	437,670	3,105,800	7.10

[1] Value reported as cement in chapter on Cement.
[2] Revised figures.
[3] No value available for stone used in manufacture of cement and lime.
[4] Value reported as lime in chapter on Lime.

The following tables show the tonnage and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1941.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1937–41

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	80,271,900	$76,972,465	8,160,670	$5,852,143	88,432,570	$82,824,608
1938	88,787,080	84,212,446	5,975,970	4,554,775	94,763,050	88,767,221
1939	96,894,220	88,988,217	6,996,800	4,970,058	103,891,020	93,958,275
1940	92,814,090	86,331,273	7,454,300	5,231,815	100,268,390	91,563,088
1941	110,192,610	106,985,808	10,771,300	7,536,451	120,963,910	114,522,259

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1941, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	952,860	$1,274,813	(1)	(1)	[2] 952,860	[2] $1,274,813
Arizona	362,790	284,984	[2] 5,000	[2] $3,600	[2] 367,790	[2] 288,584
Arkansas	[2] 562,700	[2] 506,388	[2] 27,700	[2] 25,000	1,612,770	1,555,005
California	6,947,430	4,585,155	[2] 297,590	[2] 109,129	[2] 7,245,020	[2] 4,694,284
Colorado	439,370	417,969	(1)	(1)	[2] 439,370	[2] 417,969
Connecticut	[2] 1,898,860	[2] 1,891,085	118,100	104,639	[2] 2,016,960	[2] 1,995,724
Delaware	109,510	146,822			109,510	146,822
Florida	3,393,260	3,214,494	[2] 181,470	[2] 133,303	[2] 3,574,730	[2] 3,347,797
Georgia	[2] 1,487,030	[2] 1,739,926	(1)	(1)	1,899,780	2,090,103
Hawaii	[2] 1,322,660	[2] 2,146,673	(1)	(1)	1,330,030	2,154,758
Idaho	683,410	562,582			683,410	562,582
Illinois	7,952,250	6,947,128	495,670	363,446	8,447,920	7,310,574
Indiana	[2] 3,728,840	[2] 3,469,486	242,220	164,903	[2] 3,971,060	[2] 3,634,389
Iowa	4,447,080	4,423,396	590,230	397,786	5,037,310	4,821,182
Kansas	[2] 1,971,640	[2] 2,419,461	391,520	195,008	[2] 2,363,160	[2] 2,614,469
Kentucky	[2] 4,215,470	[2] 3,730,075	459,830	259,005	[2] 4,675,300	[2] 3,989,080
Louisiana	(1)	(1)			(1)	(1)
Maine	[2] 126,880	[2] 169,180	(1)	(1)	[2] 126,880	[2] 169,180
Maryland	1,177,480	1,322,178	129,010	131,566	1,306,490	1,453,744
Massachusetts	[2] 1,924,850	[2] 2,105,829	249,260	225,772	[2] 2,174,110	[2] 2,331,601
Michigan	1,628,050	977,800	141,930	81,643	1,769,980	1,059,443
Minnesota	824,140	812,124	[2] 800	[2] 528	[2] 824,940	[2] 812,652
Mississippi	(1)	(1)			(1)	(1)
Missouri	[2] 5,016,480	[2] 5,398,413	[2] 173,910	[2] 129,075	[2] 5,190,390	[2] 5,527,488
Montana	287,190	153,695	(1)	(1)	[2] 287,190	[2] 153,695
Nebraska	119,720	161,378			119,720	161,378
Nevada	76,420	98,354			76,420	98,354
New Hampshire	[2] 140,870	[2] 187,954			[2] 140,870	[2] 187,954
New Jersey	2,717,260	2,905,610	187,120	202,270	2,904,380	3,107,880
New Mexico	21,190	38,436	(1)	(1)	[2] 21,190	[2] 38,436
New York	7,067,270	7,142,945	769,900	543,567	7,837,170	7,686,512
North Carolina	3,442,980	3,929,394	254,900	227,250	3,697,880	4,156,644
North Dakota	18,520	19,648			18,520	19,648
Ohio	6,839,820	5,607,296	1,122,580	786,711	7,962,400	6,394,007
Oklahoma	1,460,500	1,355,427	(1)	(1)	[2] 1,460,500	[2] 1,355,427
Oregon	[2] 2,487,470	[2] 1,929,672			[2] 2,487,470	[2] 1,929,672
Pennsylvania	9,589,120	9,610,005	830,920	859,383	10,420,040	10,469,388
Puerto Rico	655,990	947,867	[2] 9,640	[2] 9,746	[2] 665,630	[2] 957,613
Rhode Island	172,720	207,192			172,720	207,192
South Carolina	[2] 1,534,860	[2] 1,796,742	286,790	267,638	[2] 1,821,650	[2] 2,064,380
South Dakota	252,170	326,357	(1)	(1)	[2] 252,170	[2] 326,357
Tennessee	5,209,760	5,845,890	429,820	319,755	5,639,580	6,165,645
Texas	1,823,060	1,303,341	732,060	258,203	2,555,120	1,561,544
Utah	152,990	55,805			152,990	55,805
Vermont	58,200	87,484			58,200	87,484
Virginia	5,771,730	5,357,207	748,620	604,912	6,520,350	5,962,119
Washington	[2] 1,294,290	[2] 813,288	80,440	35,973	[2] 1,374,730	[2] 849,261
West Virginia	2,234,960	4,054,055	341,670	207,678	2,576,630	4,261,733
Wisconsin	3,187,200	2,294,254	[2] 7,760	[2] 6,210	[2] 3,194,960	[2] 2,300,464
Wyoming	667,000	536,079	(1)	(1)	[2] 667,000	[2] 536,079
Undistributed	1,736,310	1,674,472	1,464,840	882,752	1,758,660	1,175,345
	110,192,610	106,985,808	10,771,300	7,536,451	120,963,910	114,522,259

[1] Included under "Undistributed."
[2] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."

GEOGRAPHIC DISTRIBUTION OF PLANTS

Figure 3 shows the location of quarries in the United States producing concrete aggregate and road stone. Limestone quarries abound in the Appalachian Mountain area of the Eastern and Southeastern States. Granite quarries predominate in New England and are plentiful in other Eastern States. Trap rock is important in New Jersey, New York, and parts of New England.

In the Middle Western States limestone quarries predominate, but those in other kinds of rock are scattered widely, notably in the granites of the Northern States. Throughout the Rocky Mountain area quarries are relatively few; on the Pacific coast most are in rocks other than limestone.

Quarries are most numerous in the thickly populated areas of the Eastern, Middle Western, and Pacific Coast States because large demands for highways and buildings have fostered the development of many producing units. Our stone resources are enormous and widely distributed. Their development depends primarily on local market demands. Stone is available within reasonable reach of virtually every important market area.

Commercial and noncommercial operations.—The following table shows the production of crushed stone for concrete and road metal and railroad ballast during recent years by Government agencies of various kinds contrasted with that by commercial enterprises. Production by commercial companies increased 37 percent in 1941 compared with 1940, whereas production by Government agencies declined 7 percent. Seventy-one percent of the total production was made by commercial companies.

Concrete and road metal and railroad ballast sold or used by commercial and noncommercial operators in the United States, 1937–41

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers]

Year	Commercial operations				Noncommercial operations				Total	
	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Percent of change in quantity from preceding year
1937	62,315,350	$0 88	+8 4	70 5	26,117,220	$1 06	−12 3	29 5	88,432,570	+1 3
1938	60,254,170	.88	−3 3	63 6	34,508,880	1 04	+32 1	36 4	94,763,050	+7 2
1939	59,516,270	86	−1 2	57 3	44,374,750	97	+28 6	42 7	103,891,020	+9 6
1940	63,203,240	.87	+6 2	63 0	37,065,150	1 02	−16 5	37 0	100,268,390	−3.5
1941	86,360,120	.91	+36 6	71 4	34,603,790	1 04	−6 6	28.6	120,963,910	−20.6

Methods of transportation.—The following table shows the quantities of concrete and road metal conveyed during 1940 and 1941 by each of the principal methods of transportation.

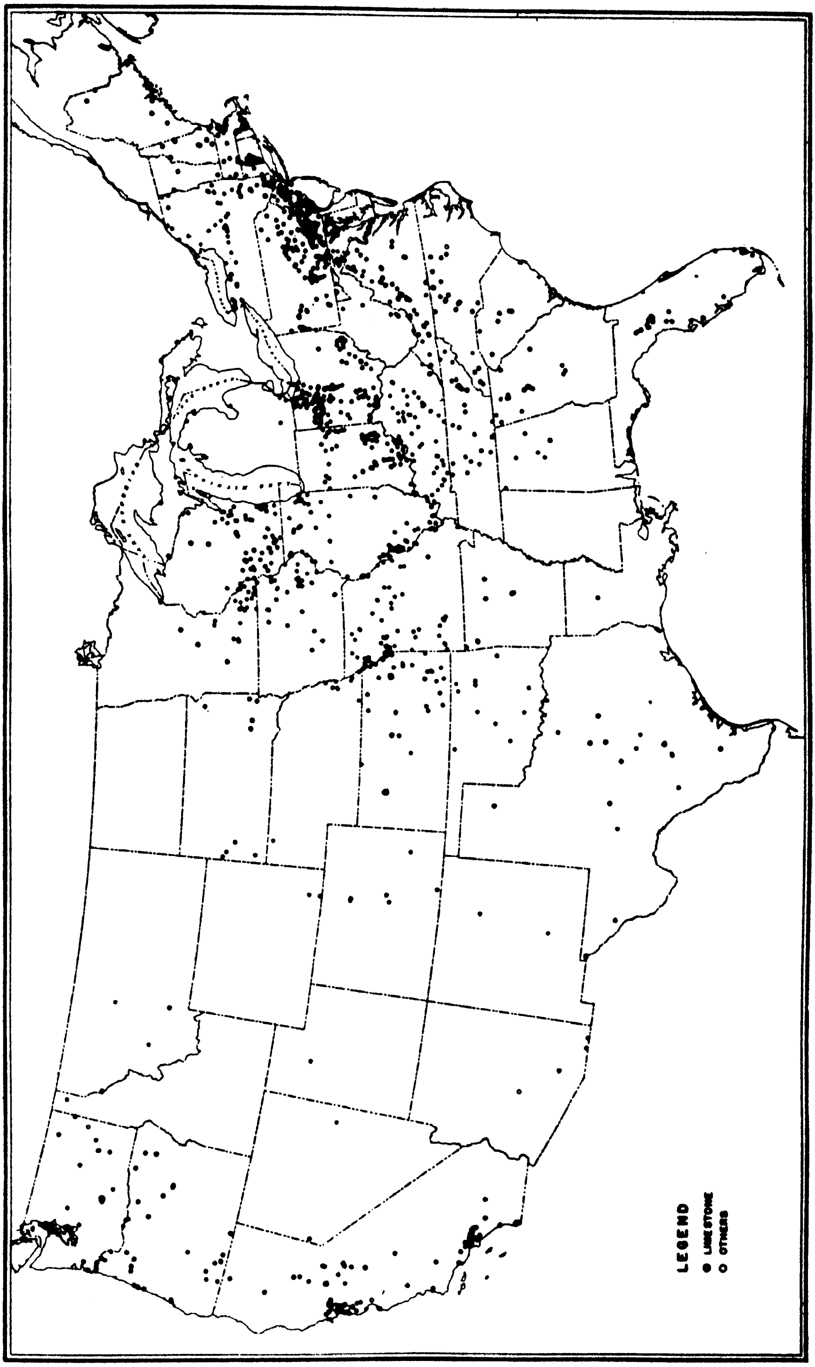

FIGURE 3.—Distribution of stone quarries producing aggregate and road stone in the United States.

Concrete and road metal sold or used by commercial producers in the United States, 1940–41, by methods of transportation [1]

Method of transportation	1940		1941	
	Short tons	Percent of total	Short tons	Percent of total
Truck	36,069,110	64.7	49,107,430	65.0
Rail	10,911,260	19.5	18,047,780	23.9
Waterway	6,072,270	11.0	4,690,770	6.2
Unspecified	2,696,300	4.8	3,742,840	4.9
	55,748,940	100.0	75,588,820	100.0

[1] For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, crushed stone for concrete and road metal moved as follows—1940: Truck 79 percent, rail 12 percent, waterway 6 percent, and unspecified 3 percent; 1941: Truck 76 percent, rail 16 percent, waterway 4 percent, and unspecified 4 percent.

GRANITE

Sales of crushed and broken granite increased 32 percent in quantity and 23 percent in value in 1941 compared with 1940. Sales of riprap were 2½ times those in 1940. Such sales commonly fluctuate greatly, as they depend chiefly on special reclamation or other projects.

Noncommercial production, which is a substantial part of the total, is reported by city, county, and State governments, highway commissions, or other Government agencies. Because the number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy from the reports submitted, the columns indicating the number of active plants (which have appeared in the granite and other tables covering the crushed-stone industry for many years before 1939) have been omitted in the reports covering 1939, 1940, and 1941.

Granite (crushed and broken stone) sold or used by producers in the United States in 1941, by States and uses

State	Riprap		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Other uses [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona			(2)	(2)			(2)	(2)	93,020	$41,032
California	951,330	$1,131,953	1,088,220	$795,357	96,130	$57,179	51,930	$16,906	2,187,610	2,001,395
Colorado	(2)	(2)	(2)	(2)					148,550	94,761
Connecticut	(2)	(2)					(2)	(2)	(2)	(2)
Delaware	340	390	109,510	146,822					109,850	147,212
Georgia	(2)	(2)	1,337,620	1,616,975	(2)	(2)	205,880	291,905	1,987,480	2,291,146
Idaho			(2)	(2)			(2)	(2)	(2)	(2)
Maine	2,600	3,484	48,830	72,354			5,720	6,011	57,150	81,849
Maryland	(2)	(2)	82,780	112,819	(2)	(2)			129,910	176,890
Massachusetts	7,650	12,814	406,200	517,505	22,570	35,000	29,090	15,536	465,510	580,855
Minnesota	5,000	4,830	25,640	46,319	800	528	680	4,450	32,120	56,127
Missouri	660	759							660	759
Montana			(2)	(2)	(2)	(2)			112,290	44,320
New Hampshire	(2)	(2)	134,810	178,251			(2)	(2)	148,730	193,998
New Jersey			68,290	80,319	2,310	2,128	4,040	7,500	74,640	89,947
New York	60,000	56,427	313,840	297,433	17,090	13,674	3,750	750	394,680	368,284
North Carolina	(2)	(2)	2,875,480	3,304,286	254,900	227,250	(2)	(2)	3,206,460	3,663,459
North Dakota	(2)	(2)	(2)	(2)					(2)	(2)
Oklahoma	(2)	(2)	(2)	(2)					(2)	(2)
Pennsylvania			365,180	430,123			13,590	13,141	378,770	443,264
Puerto Rico			(2)	(2)					(2)	(2)
Rhode Island	(2)	(2)	(2)	(2)					(2)	(2)
South Carolina	10,250	12,750	1,347,530	1,557,620	286,790	267,638	27,170	10,867	1,671,740	1,848,875
South Dakota	(2)	(2)	(2)	(2)			(2)	(2)	104,450	165,327
Tennessee			(2)	(2)					(2)	(2)
Texas	69,810	63,790							69,810	63,790
Vermont			(2)	(2)					(2)	(2)
Virginia	(2)	(2)	914,500	913,217	(2)	(2)	(2)	(2)	1,160,780	1,145,653
Washington	(2)	(2)	(2)	(2)			(2)	(2)	354,390	231,036
Wisconsin	(2)	(2)	154,910	79,605			(2)	(2)	157,140	84,124
Wyoming			(2)	(2)					(2)	(2)
Undistributed	351,700	296,610	1,042,910	747,459	601,570	538,498	117,030	147,781	470,890	322,910
	1,459,340	1,583,807	10,316,250	10,896,464	1,282,160	1,141,895	458,880	514,847	13,516,630	14,137,013
Average unit value		$1.09		$1.06		$0.89		$1.12		$1.05

[1] Includes stone used for artificial stone, asphalt filler, chips, fill material, poultry grit, road base, spalls, stone sand, and terrazzo.
[2] Included under "Undistributed."

BASALT AND RELATED ROCKS (TRAP ROCK)

Basalt, gabbro, diorite, and other dark igneous rocks (known commercially as trap rock) are used widely for highway construction and concrete aggregate. Sales of crushed and broken trap rock increased 14 percent in quantity and 23 percent in total value in 1941 compared with 1940, and the average value per ton increased from 97 cents to $1.04.

Sales of material classed as riprap, which suffered a marked decline in 1940, continued to move downward in 1941; projects using riprap probably are regarded as less essential than many others during the present war emergency. Stone used as concrete aggregate and for road construction increased 14 percent in quantity and 19 percent in value. Sales of trap rock for railroad ballast and for miscellaneous uses increased more than 60 percent.

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1941, by States and uses

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona			(2)	(2)					(2)	(2)
California	99, 950	$182, 245	963, 810	$843, 534	(2)	(2)	(2)	(2)	1, 122, 650	$1, 057, 012
Colorado	(4)	(2)	(2)	(2)					(2)	(2)
Connecticut	137, 790	104, 353	1, 898, 860	1, 891, 085	118, 100	$104, 639			2, 154, 750	2, 100, 077
Hawaii	(2)	(2)	1, 322, 660	2, 146, 673	(2)	(2)			1, 330, 170	2, 149, 535
Idaho	(2)	(2)	(2)	(2)					698, 700	582, 089
Maine			77, 220	95, 167					77, 220	95, 167
Maryland	(2)	(2)	(2)	(2)	(2)	(2)			537, 560	650, 094
Massachusetts	21, 440	22, 890	1, 361, 810	1, 400, 724	226, 690	190, 772	35, 800	$71, 592	1, 645, 740	1, 685, 978
Michigan			130, 890	145, 631					130, 890	145, 631
Minnesota	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Montana	(2)	(2)							(2)	(2)
New Hampshire			(2)	(2)					(2)	(2)
New Jersey	(2)	(2)	2, 426, 470	2, 629, 367	184, 810	200, 142	(2)	(2)	2, 708, 020	2, 936, 212
New York			(2)	(2)	(2)	(2)			687, 510	806, 955
North Carolina			255, 020	280, 536					255, 020	280, 536
Oregon	13, 220	3, 201	2, 362, 780	1, 858, 082					2, 376, 000	1, 861, 283
Pennsylvania	1, 630	1, 901	1, 067, 790	1, 013, 609	250, 420	269, 046	2, 500	1, 250	1, 322, 340	1, 285, 806
Puerto Rico			600	602	9, 640	9, 746			10, 240	10, 348
Rhode Island	1, 190	1, 190	82, 360	113, 306					83, 550	114, 496
Texas			(2)	(2)	(2)	(2)			(2)	(2)
Utah	(2)	(2)							(2)	(2)
Virginia			723, 160	570, 371	(2)	(2)	(2)	(2)	732, 500	577, 812
Washington	206, 640	256, 627	1, 247, 600	789, 969	80, 440	35, 973			1, 534, 680	1, 082, 569
Wisconsin			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Wyoming			(2)	(2)					(2)	(2)
Undistributed	137, 710	124, 725	1, 990, 060	2, 142, 799	320, 110	260, 523	164, 480	861, 850	519, 110	1, 202, 520
	619, 570	697, 132	15,914,090	15,921,455	1,190,210	1,070,841	202, 780	934, 692	17, 926, 650	18, 624, 120
Average unit value		$1. 13		$1.00		$0. 90		$4. 61		$1.04

[1] Includes stone sold for fill material, roofing granules, and unspecified uses.
[2] Included under "Undistributed."

MARBLE

Marble producers accumulate large quantities of waste material, consisting either of defective blocks or of cuttings and spalls that result from marble dressing, and they are constantly seeking profitable outlets for this waste. As the following table indicates, the price per ton realized varies greatly, because some States produce relatively high priced commodities, such as terrazzo, stucco, and marble flour, that may be worth several dollars a ton, whereas other States find outlets only in the form of riprap, road stone, and concrete aggregate that may command prices of only $1 or less a ton.

Marble (crushed and broken stone) sold by producers in the United States in 1941, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama	2	(2)	(2)	Tennessee	5	15,370	$33,593
Arkansas	2	(2)	(2)	Texas	2	(2)	(2)
California	3	1,950	$20,930	Utah	1	5,460	30,540
Georgia	1	30,000	30,432	Virginia	2	(2)	(2)
Maryland	1	2,670	22,981	Washington	4	(2)	(2)
Massachusetts	1	3,580	4,694	Undistributed	-------	45,920	260,500
Minnesota	1	(2)	(2)				
Missouri	1	2,210	11,819		28	107,160	415,489
New Jersey	1	(2)	(2)	Average unit value	-------	-------	$3.88
New York	1	(2)	(2)				

[1] Includes stone used for artificial stone, crushed stone, flux, mineral food, poultry grit, riprap, shingles, stucco, terrazzo, tile, whiting (excluding marble whiting made by companies that purchase their marble).
[2] Included under "Undistributed."

LIMESTONE

Limestone is used more widely for crushed and broken stone than any other rock, because it can be quarried and crushed at moderate cost, is available to a multitude of markets, and is essential to many chemical and manufacturing industries. In 1941 limestone constituted 73 percent of all crushed and broken stone sold (excluding that used for making cement and lime). Sales in 1941 were 19 percent higher in quantity and 25 percent higher in value than in 1940.

The following tables show production by States and uses in 1941 and sales for miscellaneous industrial uses in 1940 and 1941.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1941, by States and uses

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Other		Total	
					Concrete and road metal		Railroad ballast							
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	1,530,510	$1,321,389	758,920	$987,682	(1)	(1)	173,470	$159,340	69,520	$471,966	2,549,040	$2,948,679
Arizona			(1)	(1)	(1)	(1)							187,880	146,771
Arkansas	100	$82	1,750	2,250	273,210	254,181	27,700	$25,000	22,690	29,071	40,220	80,788	365,670	391,372
California	(1)	(1)	39,780	69,029	167,470	135,970			(1)	(1)	258,680	678,259	646,440	1,133,905
Colorado			(1)	(1)							(1)	(1)	468,760	324,499
Connecticut			(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	76,050	239,701
Florida	11,570	9,853			3,349,940	3,112,224	181,470	133,303	65,570	163,188	455,290	378,069	4,063,840	3,796,637
Georgia			(1)	(1)	149,410	122,951			80,140	125,640	(1)	(1)	307,280	470,536
Hawaii					(1)	(1)							(1)	(1)
Idaho			(1)	(1)							(1)	(1)	14,170	25,227
Illinois	149,360	156,769	563,990	532,874	7,846,250	6,879,794	495,670	363,446	2,492,870	2,311,290	195,090	369,568	11,743,230	10,613,741
Indiana	43,330	26,165	54,520	31,893	3,728,840	3,469,486	242,220	164,903	771,860	812,997	190,810	166,098	5,031,580	4,671,542
Iowa	79,060	75,847	6,190	5,404	4,447,080	4,423,396	590,230	397,786	623,970	591,693	38,900	157,707	5,785,430	5,651,833
Kansas	65,820	73,434			1,966,750	2,417,506	391,520	195,008	55,370	58,393	65,980	91,378	2,545,440	2,835,719
Kentucky	40,020	40,223			4,215,470	3,730,075	459,830	259,005	1,047,700	1,103,253	10,060	38,185	5,773,080	5,170,741
Louisiana					(1)	(1)					(1)	(1)	(1)	(1)
Maine	66,970	97,234			830	1,659			41,090	124,246	41,070	70,204	149,960	293,343
Maryland					638,990	640,659	(1)	(1)	22,340	71,411	(1)	(1)	799,980	1,046,485
Massachusetts	980	983	18,540	27,926					188,870	546,853	44,790	205,019	253,180	780,781
Michigan	11,400	4,833	8,868,030	4,747,327	1,462,410	807,445	141,930	81,643	211,070	141,223	4,287,500	2,299,500	14,982,340	8,081,971
Minnesota	12,590	11,125	380	1,000	772,730	725,590			43,460	47,296	20,270	56,258	849,430	841,269
Mississippi									500	750			500	750
Missouri	102,590	103,059	14,760	21,011	5,016,480	5,398,413	173,910	129,075	649,010	619,132	172,450	300,299	6,129,200	6,570,98[illegible]
Montana			100,980	69,138	86,160	49,017					52,670	77,345	239,810	195,500
Nebraska	152,610	186,602			119,720	161,378			(1)	(1)	(1)	(1)	328,690	660,573
Nevada			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
New Jersey			(1)	(1)	47,530	68,197			(1)	(1)	(1)	(1)	236,800	571,959
New Mexico	(1)	(1)			(1)	(1)	(1)	(1)					117,740	110,939
New York	206,920	214,107	103,170	89,881	5,896,700	5,912,923	632,810	429,393	386,950	989,762	1,737,450	1,347,455	8,964,000	8,983,521
North Carolina					172,180	192,944			28,830	23,173			201,010	216,117
Ohio	62,960	56,324	3,898,280	2,695,638	6,827,040	5,596,891	1,122,580	786,711	1,229,570	1,313,096	470,230	682,929	13,610,660	11,131,589
Oklahoma	(1)	(1)			1,373,730	1,277,378	(1)	(1)	9,860	16,263	14,620	39,569	1,783,200	1,641,390
Oregon									(1)	(1)	(1)	(1)	41,140	79,478
Pennsylvania	6,400	7,000	9,409,360	8,185,938	5,782,340	5,664,753	364,450	379,370	630,670	1,550,649	1,098,710	1,930,889	17,291,930	17,718,599
Puerto Rico					442,370	646,708	(1)	(1)			(1)	(1)	446,460	651,423
Rhode Island			(1)	(1)	(1)	(1)			(1)	(1)			(1)	(1)

South Carolina	(1)	(1)	---	---	187, 330	239, 122	---	---	(1)	(1)	---	---	369, 060	498, 165
South Dakota	(1)	(1)	---	---	81, 320	79, 155	(1)	(1)	---	---	---	---	99, 200	88, 773
Tennessee	569, 530	258, 873	36, 340	36, 338	5, 140, 430	5, 766, 066	429, 820	319, 755	1, 175, 620	1, 136, 139	422, 000	484, 565	7, 773, 740	8, 001, 736
Texas	136, 040	106, 807	(1)	(1)	1, 570, 870	1, 153, 180	617, 310	183, 553	(1)	(1)	189, 420	261, 776	2, 569, 820	1, 742, 962
Utah	---	---	185, 080	127, 888	(1)	(1)	---	---	---	---	(1)	(1)	387, 710	280, 538
Vermont	---	---	---	---	(1)	(1)	---	---	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	2, 810	3, 190	663, 120	665, 542	3, 921, 860	3, 681, 210	470, 250	358, 450	1, 069, 830	1, 009, 271	855, 750	844, 531	6, 923, 620	6, 562, 194
Washington	---	---	(1)	(1)	---	---	---	---	(1)	(1)	154, 440	317, 833	171, 970	357, 821
West Virginia	610	500	1, 448, 970	1, 093, 938	1, 554, 370	2, 638, 431	341, 670	207, 678	99, 670	177, 703	329, 660	328, 301	3, 774, 950	4, 446, 551
Wisconsin	8, 230	9, 097	47, 560	42, 329	2, 762, 790	2, 009, 223	7, 760	6, 210	537, 280	591, 100	30, 110	55, 971	3, 393, 730	2, 713, 930
Wyoming	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	---	---	(1)	(1)	213, 320	358, 374
Undistributed	447, 570	616, 478	441, 210	297, 426	671, 220	596, 872	402, 650	237, 047	311, 380	682, 899	1, 058, 140	2, 054, 270	688, 940	756, 499
	2, 177, 470	2, 058, 585	27, 432, 520	20, 064, 159	71, 432, 740	68, 840, 479	7, 093, 780	4, 657, 336	11, 909, 640	14, 395, 831	12, 303, 830	13, 788, 732	132, 349, 980	123, 905, 122
Average unit value	---	$0.95	---	$0.73	---	$0.96	---	$0.66	---	$1.21	---	$1.12	---	$0.94

[1] Included under "Undistributed."

Limestone (crushed and broken stone) sold or used by producers in the United States for miscellaneous uses, 1940–41

Use	1940		1941	
	Short tons	Value	Short tons	Value
Alkali works	4,848,490	$2,017,804	5,888,260	$2,721,635
Calcium carbide works	482,950	389,246	468,600	343,241
Coal-mine dusting	99,300	281,320	136,180	388,962
Filler (not whiting substitute):				
Asphalt	320,220	759,399	443,480	1,050,927
Fertilizer	233,990	402,191	301,650	548,104
Other	93,670	413,311	68,980	295,713
Filter beds	61,290	37,972	32,950	41,787
Glass factories	300,720	475,273	385,680	578,226
Limestone sand	407,310	311,722	877,730	812,517
Limestone whiting [1]	207,910	1,242,448	417,750	2,421,609
Magnesia works (dolomite)	80,210	105,028	105,670	136,180
Mineral food	93,160	350,964	115,400	546,784
Mineral (rock) wool	123,700	86,488	115,760	93,167
Paper mills	333,800	575,814	361,830	643,124
Poultry grit	38,910	149,050	62,070	351,809
Refractory (dead-burned dolomite)	857,950	632,582	980,190	729,792
Road base	1,129,690	843,531	575,130	441,355
Stucco, terrazzo, and artificial stone	27,320	167,368	25,840	166,021
Sugar factories	558,560	868,786	624,450	936,874
Other uses [2]	364,690	406,596	156,250	287,933
Use unspecified	68,150	112,667	159,980	252,972
	10,731,990	10,629,560	12,303,830	13,788,732

[1] Includes stone for filler for calcimine, caulking compounds, cosmetics, explosives, imitation leather, linoleum, paint, paper, parting compounds, phonograph records, plastics, pottery, putty, regrinding, roofing, rubber, sealing wax, tile, tooth powder, wire, and unspecified uses.
[2] Includes stone for acid neutralization, carbon dioxide, chemicals (unspecified), concrete blocks and pipes, dye, foundry facings, motion-picture snow, oil wells, rayon, rice milling, spalls, and spray.

Sales of dolomite (calcium-magnesium carbonate) and its primary product of calcination—dolomitic lime—for certain special uses are covered in the following table:

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1940–41

	1940	1941
Dolomite for—		
Basic magnesium carbonate:		
Short tons	80,210	105,670
Value	$105,028	$136,180
Dead-burned dolomite or refractory stone:		
Short tons	857,950	980,190
Value	$632,582	$729,792
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons	867,909	1,069,887
Value	$6,925,328	$9,111,172
Paper mills:		
Short tons	59,000	78,000
Value	$390,000	$551,000
Total (calculated as raw stone) ... short tons	2,792,000	3,382,000

Limestone is quarried not only for use raw but also for manufacture into cement and lime. The large and important industries manufacturing these products are covered in separate chapters. It is of interest, however, to show in one table, as follows, the total tonnage of limestone consumed for all purposes.

Limestone sold or used for all purposes in the United States, 1939–41, in short tons

Use	1939	1940	1941
Limestone (as given in this report) (approximate)	100,846,000	112,658,000	133,164,000
Portland cement (including "cement rock") [1] Natural cement ("cement rock") [1]	30,463,000	[2] 34,041,000	42,735,000
Lime [3]	8,509,000	9,774,000	12,159,000
	139,818,000	[2] 156,473,000	188,058,000

[1] Reported in terms of cement in chapter on Cement.
[2] Revised figures.
[3] Reported in terms of lime in chapter on Lime.

SANDSTONE

The crushed-sandstone industry made substantial gains in 1938 and 1939, receded in 1940, and advanced in 1941, when sales were 17 percent higher in quantity and 32 percent higher in value than in 1940. Unusual activity in steel plants was indicated by a 45-percent increase in sales of refractory stone (ganister). Sales of riprap were more than twice those in 1940, and the output of aggregates, road stone, and railroad ballast made large gains. Sales of sandstone applied to various miscellaneous uses dropped to about one-third their 1940 volume.

The average value per ton of refractory stone increased from $1.80 to $1.89; of riprap from 84 to 99 cents; and of aggregates from $1.07 to $1.19. Railroad ballast, however, declined from 90 to 85 cents a ton. The average sales value at the mill or quarry for all crushed sandstone was $1.26 a ton in 1941, whereas it was $1.12 in 1940.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1941, by States and uses

State	Refractory stone (ganister)		Riprap		Crushed stone				Other uses [1]		Total	
					Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(2)	(2)			(2)	(2)					207,670	$318,431
Arizona					(2)	(2)	(2)	(2)			(2)	(2)
Arkansas			(2)	(2)	(2)	(2)					823,160	869,622
California	(2)	(2)	8,840	$10,700	748,700	$617,476	620	$1,500	(2)	(2)	899,100	758,750
Colorado	19,770	$26,603	7,080	7,544	88,110	110,468					114,960	144,615
Georgia			(2)	(2)	(2)	(2)					(2)	(2)
Idaho			(2)	(2)	(2)	(2)					(2)	(2)
Illinois	(2)	(2)	(2)	(2)							(2)	(2)
Kansas			(2)	(2)	(2)	(2)					123,960	138,742
Kentucky			(2)	(2)	(2)	(2)					(2)	(2)
Maryland					(2)	(2)					(2)	(2)
Massachusetts					(2)	(2)					(2)	(2)
Michigan					(2)	(2)			(2)	(2)	(2)	(2)
Minnesota			(2)	(2)	(2)	(2)					(2)	(2)
Mississippi					(2)	(2)					(2)	(2)
Missouri			(2)	(2)							(2)	(2)
Montana			(2)	(2)	(2)	(2)					83,430	51,008
New Mexico					(2)	(2)					(2)	(2)
New York	5,380	6,725	13,860	20,032	87,570	107,426					106,810	134,183
North Carolina					(2)	(2)					(2)	(2)
North Dakota					(2)	(2)					(2)	(2)
Ohio	88,040	462,383	(2)	(2)	(2)	(2)			(2)	(2)	134,080	516,423
Oklahoma					61,380	49,200					61,380	49,200
Oregon			(2)	(2)	(2)	(2)					292,300	415,184
Pennsylvania	697,520	1,220,355	3,150	1,227	1,007,240	1,048,414	216,050	210,967	169,170	$119,304	2,093,130	2,600,267
South Dakota			(2)	(2)	69,660	81,478			(2)	(2)	111,580	126,102
Tennessee	(2)	(2)	(2)	(2)	(2)	(2)					26,840	33,341
Texas			(2)	(2)	143,470	76,317			(2)	(2)	250,180	115,478
Utah	(2)	(2)			(2)	(2)					6,600	11,993
Vermont					(2)	(2)					(2)	(2)
Virginia	(2)	(2)	(2)	(2)	143,080	134,513	(2)	(2)	(2)	(2)	268,920	233,923
Washington			(2)	(2)							(2)	(2)
West Virginia	(2)	(2)	(2)	(2)	680,590	1,415,624					772,250	1,542,289
Wisconsin	233,460	320,635	(2)	(2)	(2)	(2)			(2)	(2)	358,740	634,789

Wyoming			(2)	(2)	(2)	(2)					(2)	(2)
Undistributed	192,200	299,078	712,980	701,278	1,558,000	1,813,262	96,720	53,429	357,140	423,431	674,600	645,029
	1,236,370	2,335,779	745,910	740,781	4,587,800	5,454,178	313,390	265,896	526,310	542,735	7,409,780	9,339,869
Average unit value		$1.89		$0.99		$1.19		$0.85		$1.03		$1.26

[1] Includes sandstone used for fill material, manufacture of spun glass, poultry grit, rock dust, rock wool, roofing granules, and stone sand.
[2] Included under "Undistributed."

MISCELLANEOUS STONE

Crushed and broken stone, other than the five principal varieties already discussed, includes light-color volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows sales of stone of these types, by States and uses, in 1941; such sales increased 29 percent in quantity and 34 percent in value over 1940.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1941, by States and uses

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(2)	(2)					(2)	(2)
Arizona			125,880	$123,275	5,000	$3,600	1,500	$850	132,380	$127,725
Arkansas	(2)	(2)	289,490	252,207	(2)	(2)			598,700	487,202
California	75,410	$71,440	3,976,230	2,192,818	200,840	50,450	3,820	6,601	4,256,300	2,321,309
Colorado			(2)	(2)	(2)	(2)			168,760	83,320
Florida			43,320	102,270	(2)	(2)			(2)	(2)
Idaho			(2)	(2)					(2)	(2)
Illinois			106,000	67,334					106,000	67,334
Indiana			(2)	(2)					(2)	(2)
Kansas			4,890	1,955			5,760	11,520	10,650	13,475
Maine			(2)	(2)	(2)	(2)			4,660	6,286
Maryland			5,000	10,000					5,000	10,000
Massachusetts			156,840	187,600					156,840	187,600
Michigan			(2)	(2)			(2)	(2)	39,660	100,460
Missouri			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Montana			(2)	(2)					(2)	(2)
Nevada			(2)	(2)					(2)	(2)
New Hampshire			6,060	9,703			1,680	13,440	7,740	23,143
New Jersey			174,970	127,727			8,770	34,311	183,740	162,038
New York			(2)	(2)	(2)	(2)			201,650	118,708
North Carolina	(2)	(2)	(2)	(2)					138,470	149,168
North Dakota			(2)	(2)					(2)	(2)
Ohio			(2)	(2)					(2)	(2)
Oklahoma			(2)	(2)					(2)	(2)
Oregon			124,690	71,590					124,690	71,590
Pennsylvania	24,110	28,800	1,366,570	1,453,106			769,120	870,778	2,159,800	2,352,684
Puerto Rico			(2)	(2)					(2)	(2)
Rhode Island			(2)	(2)					(2)	(2)
South Carolina			(2)	(2)					(2)	(2)
South Dakota			(2)	(2)					(2)	(2)
Tennessee			(2)	(2)					(2)	(2)
Texas			(2)	(2)	(2)	(2)			138,470	80,494
Utah			(2)	(2)			(2)	(2)	(2)	(2)
Vermont			(2)	(2)					(2)	(2)
Virginia	(2)	(2)	69,130	57,896			(2)	(2)	(2)	(2)
Washington			46,690	23,319					46,690	23,319
Wisconsin			(2)	(2)					(2)	(2)

Wyoming			([2])	([2])			([2])	([2])	256,000	176,371
Undistributed	50,830	46,078	1,445,970	1,192,432	685,920	346,433	76,290	262,946	1,114,580	1,058,253
	150,350	146,318	7,941,730	5,873,232	891,760	400,483	866,940	1,200,446	9,850,780	7,620,479
Average unit value		$0.97		$0.74		$0.45		$1.38		$0.77

[1] Includes stone used for filler (unspecified), poultry grit, refractory, road base, rock wool, roofing granules, stucco, tennis courts, and terrazzo.
[2] Included under "Undistributed."

MARKETS

As indicated in figure 4, sales of crushed stone have maintained a reasonably close relation to total building construction and cement shipments during recent years. Concrete pavements which consist of stone and cement naturally follow the same general trends. However, sales of stone fell below pavement construction from 1932 to 1937 but attained relatively higher levels during the following years.

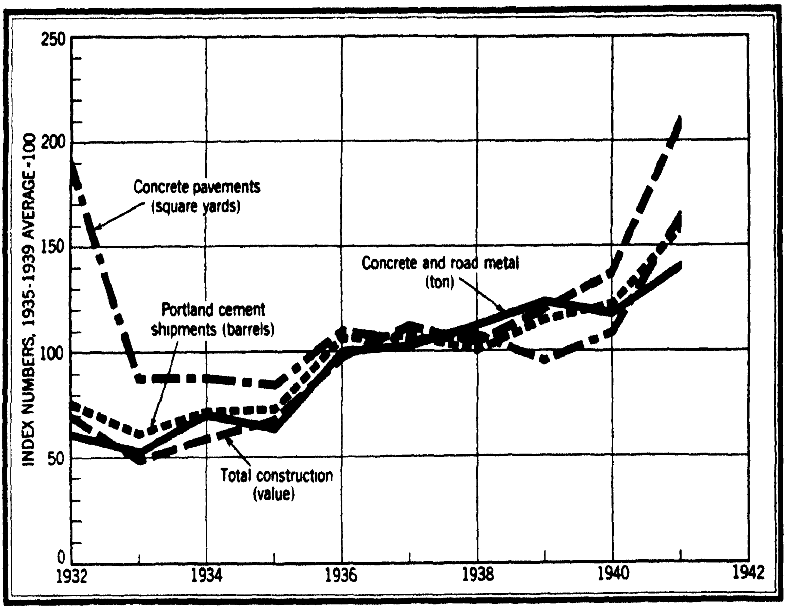

FIGURE 4.—Crushed-stone aggregates (concrete and road metal) sold or used in the United States compared with shipments of portland cement, total construction (value), and concrete pavements (contract awards, thousands of square yards), 1932–41. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

Pig-iron production reached phenomenal heights in 1941, and in consonance therewith sales of limestone used as furnace flux were the highest on record. Moreover, steel mills were everywhere producing ingots at almost maximum capacity, and naturally large quantities of dolomite and ganister were needed to make furnace linings. Forcing steel furnaces to increase their output placed an unusual demand on producers of refractories. The relations of fluxing-stone output to pig-iron production and of refractory stone to steel-ingot manufacture over a 10-year period are indicated in figure 5.

NEW DEVELOPMENTS

Several new, highly efficient, crushed-stone plants were completed during 1941. New equipment was added to several plants, and considerable rehabilitation was accomplished before such programs were interrupted by priority requirements.

Construction of the Delaware Aqueduct designed to supplement the water supply of New York City has created the unique situation of the project furnishing its own crushed stone. Large temporary crushing plants have been established to reduce the stone removed during excavation of the tunnels. The crushed stone is used as aggregate in the concrete structures of the aqueduct.

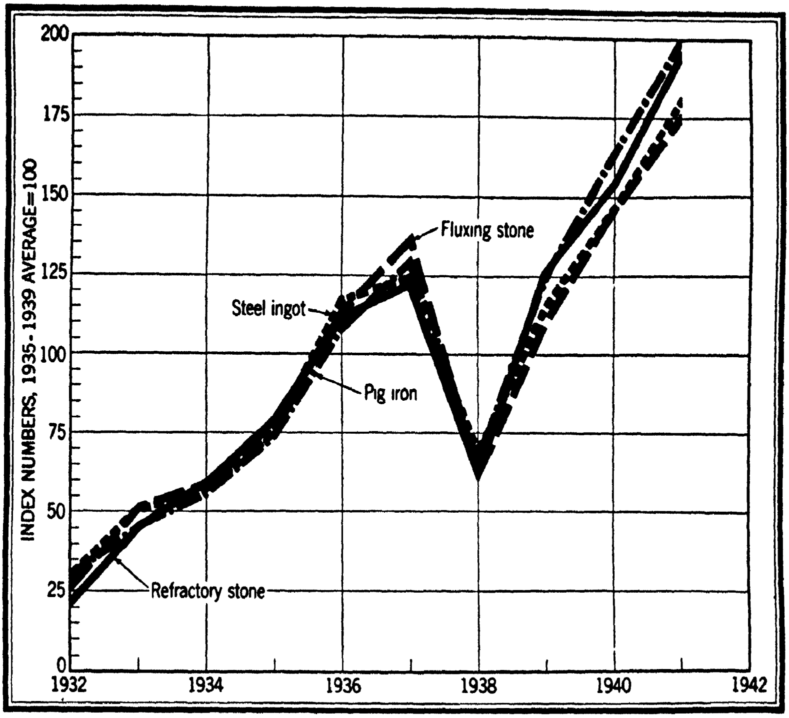

FIGURE 5.—Sales (tons) of fluxing stone and refractory stone including that used in making lime as recorded in the chapter on Lime compared with production of steel ingot and pig iron, 1932–41. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

The most striking new development in the stone industries is the newly awakened interest in dolomite as a source of magnesium metal, of which large quantities are in demand for military equipment. Added to this new and outstanding use are many other industrial applications; the most important is the greatly increasing demand for refractory dolomite used in lining steel furnaces. To supply an insistent call for information on dolomite deposits, the Bureau of Mines prepared a report[2] which appeared in November 1941. Because of the growing demand for more details concerning the dolomites of the United States, a supplementary report giving the location, extent, and chemical analyses of many deposits was in preparation early in 1942.

[2] Colby, Shirley F., Occurrences and Uses of Dolomite in the United States: Bureau of Mines Inf. Circ. 7192, 1941, 21 pp.

FOREIGN TRADE[3]

Exports.—The export trade in stone is relatively small.

Stone exported from the United States, 1937–41

Year	Marble and other building and monumental stone		Other manufactures of stone (value)	Year	Marble and other building and monumental stone		Other manufactures of stone (value)
	Cubic feet	Value			Cubic feet	Value	
1937	[1] 79,456	[1] $145,454	[2] $631,856	1940	77,896	$158,008	$264,949
1938	78,374	141,815	282,422	1941 (Jan.-Sept.)	54,062	108,706	289,860
1939	77,147	134,416	366,004				

[1] Separately classified as—Marble in blocks, rough or dressed: 19,384 cubic feet valued at $88,528; other building and monumental stone: 60,072 cubic feet valued at $56,926.
[2] Separately classified as—Marble, breccia, and onyx, $33,307; limestone, $201,580; other manufactures of stone, $396,969.

Imports.—Owing to military restrictions, imports in 1941 can be published for only the first 9 months. As might be inferred from the far-reaching and intensified effects of the war, imports of stone were very small; from sources outside the American Continent they were almost negligible.

Stone imported for consumption in the United States in 1941 (January–September, inclusive), by classes

Class	Quantity	Value	Class	Quantity	Value
Marble, breccia, and onyx:			Quartzite.....short tons..	62,048	$111,055
In blocks, rough, etc. cubic feet..	17,121	$94,247	Travertine stone: Rough.....cubic feet..	1,995	3,295
Slabs or paving tiles superficial feet..	413	737	Stone (other):		
All other manufactures........	....	5,875	Dressed........	......	530
	....	100,859	Rough (monumental or building stone).....cubic feet..	1,250	5,580
Granite:			Rough (other).....short tons..	45,622	28,623
Dressed.....cubic feet.	6,598	10,262	Marble chip or granito short tons..	102	794
Rough.....do....	733	4,524		......	35,527
	7,331	14,786	Grand total........	....	265,522

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Stone imported for consumption in the United States in 1941 (January to September, inclusive), by classes and countries

Country	Marble, breccia, and onyx			Granite		Other building or monumental stone (value)	Other stone, n. e. s. (value)	Quartzite		Travertine		Total value
	Rough		Manufactures (value)	Cubic feet	Value			Short tons	Value	Cubic feet	Value	
	Cubic feet	Value										
North America:												
Canada	91	$413	$3	5,960	$8,504	$134	$28,623	62,048	$111,055			$148,732
Cuba			20				773					793
Mexico	11,175	41,069	443									41,512
Total North America	11,266	41,482	466	5,960	8,504	134	29,396	62,048	111,055			191,037
South America:												
Argentina	4,888	50,632	218							1,225	$2,476	53,326
Brazil				872	4,560							4,560
Chile	65	172					21					193
Peru	3	18	103							770	819	940
Total South America	4,956	50,822	321	872	4,560		21			1,995	3,295	59,019
Europe:												
Belgium			63									63
Finland				22	146							146
France			52									52
Italy			156									156
Portugal	739	1,545	3,268									4,813
United Kingdom	160	398	554	194	399	21						1,372
Other Europe			62			6						68
Total Europe	899	1,943	4,155	216	545	27						6,670
Asia			1,670	283	1,177	369						3,216
Africa						5,580						5,580
Grand total	17,121	94,247	6,612	7,331	14,786	6,110	29,417	62,048	111,055	1,995	3,295	265,522

SLATE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

Sales of slate as dimension stone increased 17 percent in quantity and 28 percent in value in 1941 compared with 1940. Sales were approximately the same in quantity as in 1939, but the value was considerably higher. In nearly all categories unit prices were substantially higher than in 1940.

Roofing-slate sales gained 9 percent in quantity over 1940 but were still much lower than in 1939. The value of sales, however, was the highest in any year since 1930. The average value per square in 1941 was $8.39, whereas in 1940 it was $7.02. Sales in the Pennsylvania area were 15 percent higher in quantity and 44 percent higher in value than in 1940. In the New York-Vermont area sales declined 4 percent in quantity but gained 10 percent in value. Virginia sales increased 6 percent in quantity and 15 percent in value.

Sales of mill stock increased 4 percent in quantity and 15 percent in value compared with 1940. Although total new construction increased from 137 percent of the 1935–39 average in 1940 to 208 percent in 1941, sales of structural and sanitary slate declined 1 percent, indicating a growing trend toward substitution of other materials. Sales of electrical slate (reflecting the rapidly increasing electric-power output) increased 43 percent in quantity and 50 percent in value and reached the highest level of output since 1930. Sales of vaults and covers show little change from 1940—a gain of 2 percent in quantity and of 9 percent in value. Sales of blackboards and bulletin boards, which have declined sharply during the past 2 years, were the lowest since 1934. The year 1941 showed a 16-percent decrease in quantity and 14-percent in value compared with 1940. Sales of billiard-table tops, which in 1940 attained the highest level since 1928, receded slightly in 1941—1 percent in quantity and 11 percent in value. Sales of school slates increased 26 percent in quantity and 42 percent in value. Both the quantity and value of flagstones and stepping stones were more than twice those in 1940.

Statistics on slate granules and flour are included in this chapter, although these products have little connection with the dimension-slate industry except that granules are used in roofing products that compete in the roofing-slate market. For the most part, slate used for the manufacture of granules is unsuitable for other slate products. Sales of granules increased 40 percent in quantity and 35 percent in value and sales of flour 29 percent in quantity and 36 percent in value compared with 1940. The great increase in sales of granules probably reflects the extensive program of building military camps and other more or less temporary structures in connection with the preparedness program. The average sales value of granules f. o. b. mill was $8.37

and flour $3.49 per short ton in 1941 compared with $8.72 and $3.31, respectively, in 1940. Figures for sales of granules made of rock other than slate are given in the chapter of this volume on Stone.

The following table, presenting the principal statistical data for the slate industry during 1940 and 1941, is arranged to permit ready comparison of the 2 years.

Salient statistics of the slate industry in the United States, 1940–41

	1940			1941				
	Quantity			Quantity			Percent of change in—	
	Unit of measurement	Approximate equivalent short tons	Value	Unit of measurement	Approximate equivalent short tons	Value	Quantity (unit as reported)	Value
Domestic production (sales by producers):								
Roofing slate	*Squares* 347, 130	127, 600	$2, 436, 123	*Squares* 378, 980	140, 830	$3, 180, 766	+9. 2	+30. 6
Mill stock:	*Sq. ft.*			*Sq. ft.*				
Electrical slate	440, 080	3, 710	319, 163	628, 720	5, 870	477, 047	+42. 9	+49. 5
Structural and sanitary slate	748, 160	6, 010	240, 355	738, 220	5, 740	254, 616	−1. 3	+5. 9
Grave vaults and covers	251, 070	2, 390	57, 604	255, 890	2, 410	63, 030	+1. 9	+9. 4
Blackboards and bulletin boards	1, 023, 250	2, 620	229, 687	857, 990	2, 230	198, 466	−16. 2	−13. 6
Billiard-table tops	243, 700	1, 890	80, 364	241, 620	1, 880	71, 388	−. 9	−11. 2
School slates	[1] 413, 860	450	8, 637	[1] 522, 830	550	12, 267	+26 3	+42. 0
Total mill stock	3, 120, 120	17, 070	935, 810	3, 245, 270	18, 680	1, 076, 814	+4 0	+15 1
Flagstones, etc.[2]	1, 380, 040	9, 780	64, 435	3, 002, 380	21, 480	152, 254	+117. 6	+136 3
Total slate as dimension stone		154, 450	3, 436, 368		180, 990	4, 409, 834	+17. 2	+28. 3
Granules and flour		319, 000	2, 301, 901		437, 670	3, 105, 800	+37. 2	+34 9
Grand total domestic production		473, 450	5, 738, 269		618, 660	7, 515, 634	+30 7	+31. 0
Foreign trade:								
Imports for consumption			520			[3] 1, 504		
Exports:[4]	*Squares*							
Roofing	475		5, 547	(6)	(6)	(6)	(6)	(6)
Other dimension slate			[5] 70, 109					
Granules and flour			(6)					

[1] Square feet approximate. Number of pieces: 1940, 773,690; 1941, 977,250.
[2] Includes walkways, stepping stones, and miscellaneous slate.
[3] January to September, inclusive.
[4] Figures obtained by Bureau of Mines from shippers.
[5] Exclusive of structural slate. Bureau of Mines not at liberty to publish figures.
[6] Bureau of Mines not at liberty to publish figures.

SALES

Dimension slate.—All slate products except granules and flour are classed as dimension slate because they consists of blocks or slabs cut to specified sizes and shapes. The following table shows sales of these products for a 5-year period.

Slate (other than granules and flour) sold by producers in the United States, 1937–41

Year	Roofing			Mill stock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1937	365, 800	137, 400	$2, 728, 109	21, 480	$1, 225, 645	8, 670	$73, 554	167, 550	$4, 027, 308
1938	322, 040	119, 590	2, 247, 910	16, 310	853, 602	7, 790	63, 839	143, 690	3, 165, 351
1939	399, 320	149, 410	2, 868, 961	21, 710	1, 168, 671	8, 480	63, 493	179, 600	4, 101, 125
1940	347, 130	127, 600	2, 436, 123	17, 070	935, 810	9, 780	64, 435	154, 450	3, 436, 368
1941	378, 980	140, 830	3, 180, 766	18, 680	1, 076, 814	21, 480	152, 254	180, 990	4, 409, 834

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Figure 1 compares sales of roofing slate, as well as all slate except granules and flour, with the number of new residential units and total

new construction from 1920 to 1941. Roofing slate is used principally in residential construction, but mill stock such as structural and sanitary products is used more generally in nonresidential building. Roofing slate failed to pace new residential building from 1921 to 1929, but thereafter both maintained a fairly uniform slow tempo until 1938.

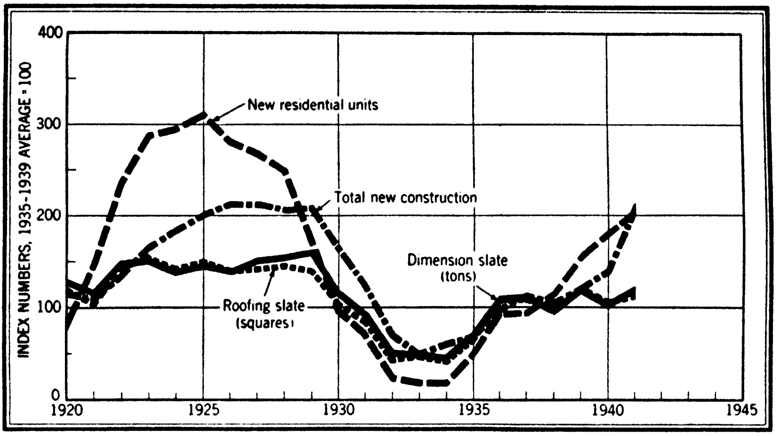

FIGURE 1.—Sales of dimension slate and roofing slate compared with total new construction and new residential units, 1920–41. Data on new construction from Bureau of Foreign and Domestic Commerce and on new residential units from Bureau of Labor Statistics.

From 1939 to 1941 new residential units increased greatly, but roofing slate made relatively small gains. The same general relationships hold when total dimension slate is compared with total new construction.

Figure 2 presents graphically a statistical history of all slate products except school slates over a 27-year period. The industry reached

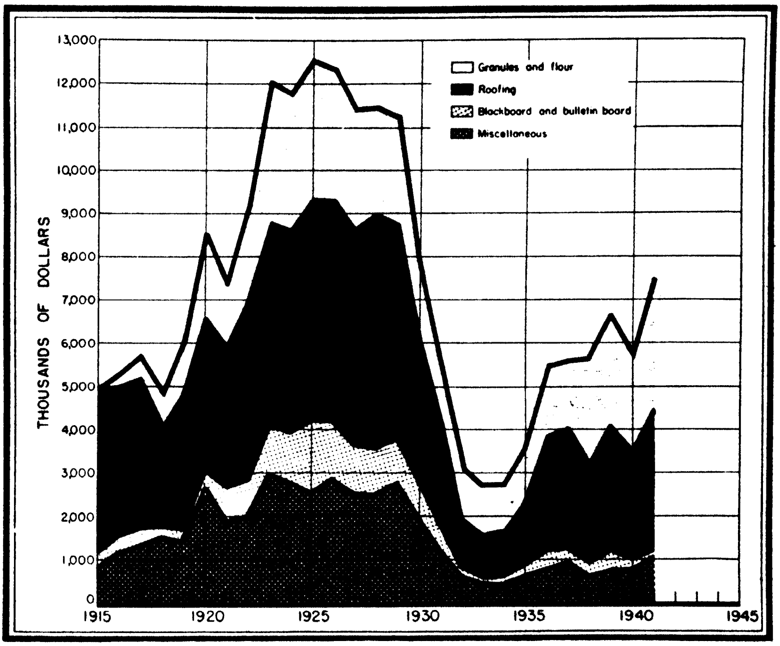

FIGURE 2.—Value of slate sold in the United States, 1915–41, by uses.

its peak of productive activity in 1925 and had already experienced a moderate decline at the beginning of the depression that culminated in 1933 in the smallest sales in any year since slate production was an infant industry. Subsequent recovery was strong at first but is still far below the 1925 level.

Figure 3 presents the same history as figure 2, except that quantities rather than values are used. Roofing granules and flour are most important upon a tonnage basis. Mill stock has a relatively high unit value, and the quantities involved are not great. It is noteworthy that for the year of peak production the value of mill stock was much greater than that of granules and flour, but upon a quantity basis mill-stock sales comprised scarcely one-tenth the tonnage of granules and flour.

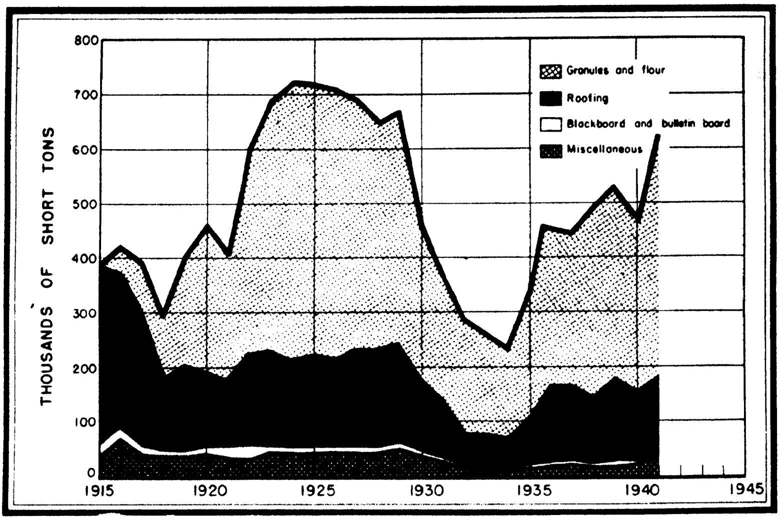

FIGURE 3.—Quantity of slate sold in the United States, 1915–41, by uses.

Granules and flour.—Slate granules are used extensively in surfacing prepared roofing; and slate flour is employed as a filler in paints, road asphalt-surface mixtures, roofing mastic, oilcloth, linoleum, and various other products. The following table shows sales of granules and flour by producers from 1937 to 1941.

Crushed slate (granules and flour) sold by producers in the United States, 1937–41

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	193,950	$1,309,549	83,060	$268,465	277,010	$1,578,014
1938	258,930	2,220,306	90,070	269,656	349,000	2,489,962
1939	265,830	2,312,177	85,950	268,912	351,780	2,581,089
1940	230,440	2,009,151	88,560	292,750	319,000	2,301,901
1941	323,740	2,708,246	113,930	397,554	437,670	3,105,800

PRICES

The average price of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines, increased $1.37 a square in 1941 compared with 1940. In Pennsylvania it increased $1.65, in the Vermont-New York area $1.04, and in Virginia 74 cents a square.

The price of mill stock increased from 30 cents a square foot in 1940 to an average of 33 cents in 1941. Average values of electrical, struc-

tural and sanitary slate, grave vaults and covers, and blackboards and bulletin boards increased moderately, whereas slate for billiard-table tops declined 3 cents a square foot. The average price of roofing granules and flour declined 12 cents a ton from 1940.

Price history.—Figure 4 shows the trend in slate prices compared with building materials in general over a 27-year period. Slate prices were lower than those of building materials in general from 1915 to 1920, but from that time until 1932 prices of both roofing and mill stock were well above the average of all building materials. Since 1932 slate prices have varied only moderately from the general average.

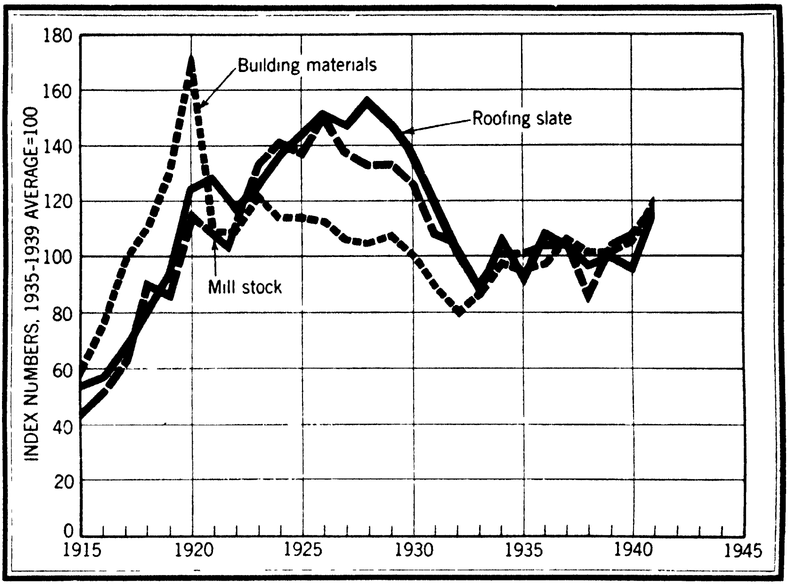

FIGURE 4.—Prices of slate compared with wholesale prices of building materials in general, 1915–41. Wholesale prices are from Bureau of Labor Statistics.

REVIEW BY STATES AND DISTRICTS

The following table gives sales of slate in 1941, by States and uses.

Slate sold by producers in the United States in 1941, by States and uses

State	Operators	Roofing		Mill stock		Other uses [1] (value)	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	2					(2)	(2)
California	1					$53,765	$53,765
Georgia	1					(2)	(2)
Maine	3	3,270	$27,300	519,880	$414,912		442,212
Maryland	1					(2)	(2)
New York	11	1,780	18,579	(3)	(3)	[3] 666,566	685,145
Pennsylvania [4]	25	248,980	2,075,490	2,584,310	582,443	806,415	3,464,348
Vermont	35	83,780	680,805	141,080	79,459	1,161,659	1,921,923
Virginia	6	41,170	378,592			(2)	(2)
Undistributed [5]						569,649	948,241
Total, 1941	85	378,980	3,180,766	[3] 3,245,270	[3] 1,076,814	[3] 3,258,054	7,515,634
1940	98	347,130	2,436,123	[3] 3,120,120	[3] 935,810	[3] 2,366,336	5,738,269

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] Small amount of mill stock from New York in 1941 and from Vermont in 1940 included under "Other uses."
[4] For details of production in Pennsylvania, see following table.
[5] Includes output of States entered as "(2)" above.

Maine.—Sales of electrical slate—principal product of the Maine quarries—continued to climb in 1941, as shown by a 54-percent increase in total value of slate products sold compared with 1940, which, in turn, followed a 33-percent increase in 1940 from 1939. The growing demand for electrical slate accords with the great increase in electric-power production, which advanced from about 3 to 3½ billion kilowatt-hours from January to December 1941. Roofing slate, which is of minor importance in Maine, made a moderate gain.

New York-Vermont.—The number of squares of roofing slate sold in the New York-Vermont area in 1941 was 4 percent lower than in 1940, following an 18-percent decline in 1940 from 1939; unit prices were, however, so much higher in 1941 that the value of sales gained 10 percent. Mill-stock sales in this area receded 10 percent in quantity but gained 1 percent in value; and the value of other products, chiefly granules and flour, increased 39 percent. The value of all slate products sold in Vermont in 1941 was 24 percent higher and in New York 43 percent higher than in 1940. These substantial gains were, however, confined almost entirely to products other than roofing and mill stock.

Peach Bottom district.—Blue-black slate has been quarried for more than 200 years on the Maryland-Pennsylvania border near Delta, Pa. Roofing slate is now produced only on the Pennsylvania side of the line, but granules and slate flour are manufactured in both States.

Lehigh district.—The most productive slate area in the United States is in Lehigh and Northampton Counties, Pa. All kinds of slate products are manufactured in this district. As separate figures cannot be shown for York County, Pa., it is included with Northampton County in the accompanying table for Pennsylvania.

The value of total sales of slate products in the district was 33 percent higher in 1941 than in 1940. Sales of roofing slate increased 15 percent in quantity and 44 percent in value. The following mill-stock products showed gains in both quantity and value in 1941: Electrical

Slate sold by producers in Pennsylvania in 1941, by counties and uses

County	Operators	Roofing slate		Mill stock					
		Squares (100 square feet)	Value	Electrical		Structural and sanitary		Vaults and covers	
				Square feet	Value	Square feet	Value	Square feet	Value
Lehigh	8	17,590	$108,120	54,310	$25,217	6,740	$2,337	(1)	(1)
Northampton and York [2]	17	231,390	1,967,370	24,950	10,279	631,940	204,544	[1] 246,700	[1] $59,659
Total 1941	25	248,980	2,075,490	79,260	35,496	638,680	206,881	246,700	59,659
1940	27	216,020	1,444,696	48,440	22,110	677,940	204,716	251,070	57,604

County	Mill stock—Continued						Other uses (value)	Total value
	Blackboards and bulletin boards		Billiard-table tops		School slates			
	Square feet	Value	Square feet	Value	Square feet	Value		
Lehigh	177,830	$35,205			522,830	$12,267	(3)	[1 3] $183,146
Northampton and York [2]	680,160	163,261	238,850	$69,674			[3] $806,415	[1 3] 3,281,202
Total: 1941	857,990	198,466	238,850	69,674	522,830	12,267	806,415	3,464,348
1940	1,023,250	229,687	243,700	80,364	413,860	8,637	561,987	2,609,801

[1] Small amount of slate for grave vaults and covers produced in Lehigh County included under Northampton and York Counties.
[2] York County produced roofing slate, granules, and flour only
[3] Small amount of flagging produced in Lehigh County included under Northampton and York Counties.

slate (64 percent in quantity and 61 percent in value) and school slates (26 percent in quantity and 42 percent in value). Blackboard and bulletin-board sales declined 16 percent in quantity and 14 percent in value. There were only small changes in sales of structural and sanitary slate, vaults and covers, and billiard-table tops. Other products, chiefly granules and flour, gained 43 percent in value compared with 1940.

Virginia.—Sales of blue-black roofing slate—principal product of the Buckingham County area—increased moderately in 1941 compared with 1940. The granule industry of Esmont, Albemarle County, and New Canton, Buckingham County, was active.

Other districts.—A small quantity of granules was produced in Arkansas at Caddo Gap, Montgomery County, and near Mena, Polk County. Larger quantities of granules and flour than in 1940 were produced near Placerville, Eldorado County, Calif., and Bartow County, Ga., near Fair Mount.

Map of slate areas.—The accompanying map, figure 5, shows the location of slate mines and prospects in the United States. The prospects indicated are confined to those that have actually produced slate in substantial quantities some time during their history. As slate is a product of extreme regional metamorphism, active operations are

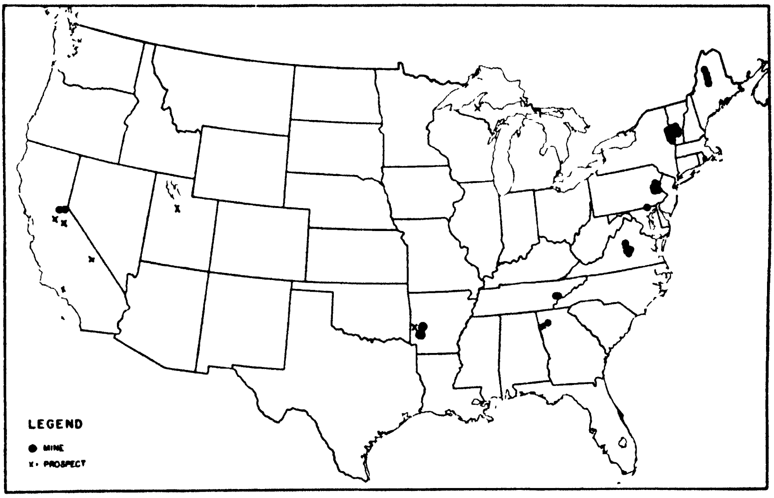

FIGURE 5.—Location of slate mines and prospects in the United States.

confined chiefly to the highly altered rocks of the eastern Appalachian belt extending from Maine to Georgia. No other slate areas have proved adequate to support sustained production, except on a small scale. Very little slate other than granules and flagging has been produced west of the Appalachian area or south of Virginia for many years.

NEW DEVELOPMENTS

The slate industry of the United States faces an unusual opportunity for winning new markets during the present emergency. The war program has created an unparalleled and ever-increasing demand for metals of all kinds; for lumber; and for the essentials of prepared roofing, namely, rag or wood-pulp felts and asphalt. On the other

hand, slate has few direct military uses and therefore may be utilized freely as roofing and for many interior structural applications, unhampered by priorities. Its wider use would thus release larger quantities of the more essential commodities for war needs. Furthermore, it has been found in England that slate roofs offer superior bombing protection and are particularly effective in reducing the spread of fires caused by incendiary bombs. Slate is used extensively in rebuilding bomb-devastated areas in Great Britain.

The field for expansion of the United States slate industry is very broad. Although slate roofs are waterproof, attractive, and unusually enduring, they cover only 1 percent or less of our homes. The North Wales slate industry alone employs more than 8,000 workers in normal times; the entire United States slate (excluding granules) industry employed less than 1,000 wage earners in 1939, according to the Bureau of the Census.

FOREIGN TRADE [1]

Imports.—Imports of slate into the United States are very small. Their value for the past 5 years is indicated in the following table. Owing to war-time restrictions, data for 1941 have been released for only the first 9 months.

Slate imported for consumption in the United States, 1937–41, by countries

Country	1937	1938	1939	1940	1941 (Jan.-Sept.)
Canada	$826	$543	$570		$71
China		3	26	$21	45
Czechoslovakia	990	1,037			
France		895			
Germany	17				
Hong Kong	20	59	4		
Italy	349	994	356	324	
Japan	222	68	61	175	7
Norway	381				
United Kingdom	2,019	3,089			1,381
	4,824	6,688	1,017	520	1,504

Exports.—The following table lists the value of exports of slate products from 1937 to 1940, as reported to the Bureau of Mines by shippers.

Slate exported from the United States, 1937–40, by uses [1]

Use	1937	1938	1939	1940
Roofing	$9,382	$5,070	$5,244	$5,547
School slates	35,011	35,717	[2] 17,739	[2] 36,503
Electrical	2,356	1,239	1,726	4,721
Blackboards	6,853	10,400	8,448	4,688
Billiard tables	16,580	10,182	18,111	24,197
Structural [3]	4,393	1,314	5,791	121,038
Slate granules and flour	77,576	93,675	120,731	
	152,151	157,597	177,790	196,694

[1] Figures collected by Bureau of Mines from shippers of products named.
[2] Includes slate used for pencils and educational toys
[3] Includes slate for floors and walkways.

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

SAND AND GRAVEL

By OLIVER BOWLES AND G. E. TUCKER

SUMMARY OUTLINE

SUMMARY

Production of sand and gravel totaled 288,715,000 short tons in 1941 and surpassed all previous records. The quantity sold or used was 21 percent and the total value 33 percent higher than in 1940. The substantial gains were confined to commercial operations; Government-and-contractor [1] production was virtually unchanged. The average value per ton of all material handled was 51 cents in 1941 at point of production compared with 46 cents in 1940 and 47 cents in 1939. The quantity and value of total production over a period of years are indicated in figure 1.

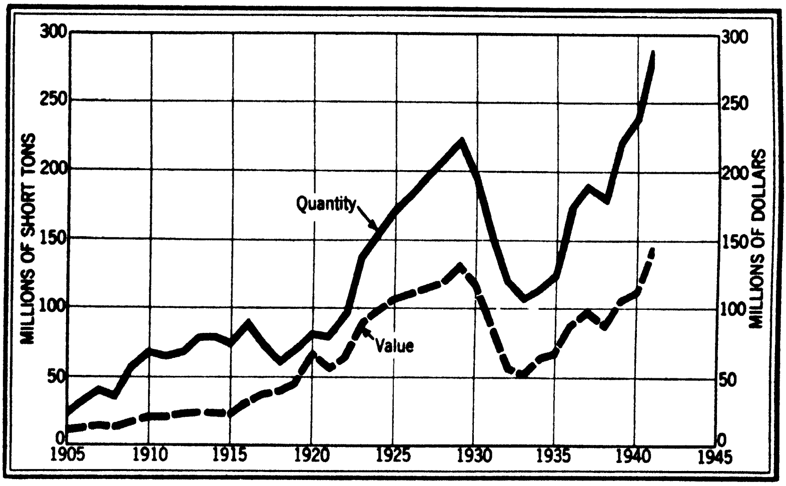

FIGURE 1.—Total production of sand and gravel in the United States, 1905–41.

As the major uses of sand and gravel are for concrete aggregate and road stone, a substantial increase in sales was to be expected in view of the fact that the value of all construction in 1941 was more than twice the 1935–39 average, and awards on contracts for concrete pavement (in thousands of square yards) were 36 percent greater in 1941 than in 1940.

Sales of industrial sands also made large gains. Molding and fire or furnace sands naturally registered substantial gains because of unusual

[1] Prior to 1939 classified as "noncommercial"; details of change in designation given in Minerals Yearbook, 1940, Review of 1939, p. 1214.

activity in foundry work in connection with the program of military preparedness.

Salient statistics on sand and gravel for 1940 and 1941 are summarized in the following table.

Sand and gravel sold or used by producers in the United States, 1940–41, by commercial and Government-and-contractor operations and by uses

	1940			1941			Percent of change in—	
	Short tons	Value		Short tons	Value			
		Total	Average		Total	Average	Tonnage	Average value
COMMERCIAL OPERATIONS								
Sand:								
Glass	2,759,544	$4,881,508	$1.77	3,475,111	$6,113,529	$1.76	+26.0	−0.6
Molding	5,004,807	5,268,974	1.05	7,246,081	8,412,725	1.16	+44.8	+10.5
Building	29,591,644	15,243,151	.52	40,164,731	21,698,378	.54	+35.7	+3.8
Paving	20,812,866	10,930,249	.53	27,013,283	14,834,378	.55	+29.8	+3.8
Grinding and polishing [1]	856,309	915,925	1.07	1,001,814	1,388,966	1.39	+17.0	+30.0
Fire or furnace	270,715	325,713	1.20	325,803	357,240	1.10	+20.3	−8.3
Engine	1,634,968	1,069,630	.65	2,022,782	1,312,433	.65	+23.7	-----
Filter	118,600	164,061	1.38	263,966	324,107	1.23	+122.6	−10.9
Railroad ballast [2]	957,745	256,439	.27	1,634,335	445,181	.27	+70.6	-----
Other [3]	1,923,042	1,469,979	.76	2,022,604	1,455,384	.72	+5.2	−5.3
Total commercial sand	63,930,240	40,525,629	.63	85,170,510	56,342,321	.66	+33.2	+4.8
Gravel:								
Building	23,429,541	15,205,100	.65	37,900,243	26,729,788	.71	+61.8	+9.2
Paving	30,308,100	17,879,012	.59	38,310,304	24,624,898	.64	+26.4	+8.5
Railroad ballast [4]	10,880,779	3,627,796	.33	16,302,175	5,456,300	.33	+49 8	-----
Other [5]	2,707,607	1,032,597	38	3,873,235	1,553,606	.40	+43.1	+5.3
Total commercial gravel	67,326,027	37,744,505	56	96,385,957	58,364,592	.61	+43.2	+9.0
Total commercial sand and gravel	131,256,267	78,270,134	.60	181,556,467	114,706,913	.63	+38.3	+5.0
GOVERNMENT-AND-CONTRACTOR OPERATIONS [6]								
Sand:								
Building	5,149,000	2,039,000	.40	5,789,000	1,797,000	.31	+12.4	−22.5
Paving	9,595,000	2,767,000	.29	12,876,000	4,013,000	.31	+34 2	+6.9
Total Government-and-contractor sand	14,744,000	4,806,000	.33	18,665,000	5,810,000	.31	+26.6	−6.1
Gravel.								
Building	9,866,000	4,922,000	50	8,779,000	3,797,000	.43	−11 0	−14.0
Paving	82,442,000	22,690,000	.28	79,715,000	22,893,000	.29	−3.3	+3.6
Total Government-and-contractor gravel	92,308,000	27,612,000	.30	88,494,000	26,690,000	.30	−4.1	-----
Total Government-and-contractor sand and gravel	107,052,000	32,418,000	.30	107,159,000	32,500,000	.30	+ 1	-----
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand	78,674,000	45,332,000	.58	103,835,000	62,152,000	.60	+32 0	+3.4
Gravel	159,634,000	65,356,000	.41	184,880,000	85,055,000	.46	+15.8	+12.2
Grand total	238,308,000	110,688,000	.46	288,715,000	147,207,000	.51	+21.2	+10.9

[1] Includes blast sand as follows—1940. 256,104 tons valued at $597,198, 1941 371,049 tons, $912,626.
[2] Includes ballast sand produced by railroads for their own use as follows—1940. 57,741 tons valued at $9,506; 1941. 37,911 tons, $5,676.
[3] Includes some sand used by railroads for fills and similar purposes as follows—1940. 207,941 tons valued at $44,064; 1941· 351,537 tons, $36,737.
[4] Includes ballast gravel produced by railroads for their own use as follows—1940· 4,913,809 tons valued at $914,990; 1941: 7,536,591 tons, $1,506,121.
[5] Includes some gravel used by railroads for fills and similar purposes as follows—1940: 793,709 tons valued at $133,405, 1941. 1,157,557 tons, $128,993
[6] Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease

PRODUCTION

As stocks of sand and gravel in the hands of producers are seldom large and as they do not vary greatly from year to year, the quantities of materials sold or used are virtually equivalent to production. Throughout this report sales and production are used interchangeably. The following table segregates sand and gravel and summarizes total production of each over a 5-year period.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1937–41

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	63,385,071	$40,412,497	126,275,352	$57,060,500	189,660,423	$97,472,997
1938	57,113,828	33,935,725	124,206,405	51,987,122	181,320,233	85,922,847
1939	72,542,000	41,608,000	153,466,000	64,458,000	226,008,000	106,066,000
1940	78,674,000	45,332,000	159,634,000	65,356,000	238,308,000	110,688,000
1941	103,835,000	62,152,000	184,880,000	85,055,000	288,715,000	147,207,000

Details on production in 1941, by States and uses, are presented in the following tables. California, New York, Illinois, Ohio, Michigan, and Pennsylvania, in the order named, were the leading States in commercial output in 1941; each produced over 10 million tons.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1941, by States

State	Short tons	Value	State	Short tons	Value
Alabama	2,428,995	$1,556,457	New Hampshire	1,894,074	$336,538
Alaska	[1] 530,997	[1] 87,116	New Jersey	5,964,869	4,897,039
Arizona	702,889	335,474	New Mexico	[1] 1,948,587	[1] 1,269,813
Arkansas	3,587,906	1,798,307	New York	[2] 14,923,149	[2] 10,096,875
California	[2] 19,617,609	[2] 10,988,766	North Carolina	4,473,297	2,345,165
Colorado	[2] 809,270	[2] 528,116	North Dakota	2,636,039	238,864
Connecticut	2,076,977	941,902	Ohio	12,473,145	9,230,358
Delaware	168,359	102,854	Oklahoma	1,513,988	627,864
Florida	1,462,276	949,980	Oregon	3,968,395	2,159,470
Georgia	615,511	283,148	Pennsylvania	10,515,940	9,936,898
Idaho	2,846,752	882,867	Puerto Rico	([1])	([2])
Illinois	13,888,985	8,271,170	Rhode Island	649,289	459,223
Indiana	8,897,976	4,560,652	South Carolina	1,125,725	611,469
Iowa	6,271,702	1,728,741	South Dakota	2,627,059	559,766
Kansas	2,927,921	1,288,920	Tennessee	4,811,686	2,829,836
Kentucky	[2] 1,654,183	[2] 1,124,705	Texas	12,134,312	6,681,277
Louisiana	3,700,140	2,386,097	Utah	2,760,025	935,371
Maine	3,891,656	935,902	Vermont	[1] 601,918	[1] 127,149
Maryland	5,167,445	4,446,850	Virginia	4,593,193	3,770,650
Massachusetts	5,351,002	2,674,557	Washington	5,583,285	2,476,834
Michigan	15,606,215	6,190,336	West Virginia	2,733,607	3,185,639
Minnesota	13,517,069	2,705,534	Wisconsin	9,263,237	3,398,039
Mississippi	[2] 2,192,829	[2] 1,018,504	Wyoming	2,003,663	840,933
Missouri	5,401,903	3,220 086	Undistributed [3]	46,147,000	17,145,000
Montana	4,706,685	1,871,912			
Nebraska	3,176,701	1,273,066		288,715,000	147,207,000
Nevada	2,170,145	894,721			

[1] Output of commercial producers included under "Undistributed"
[2] Output of Government-and-contractor operations included under "Undistributed."
[3] Includes items covered by "1" and "2"

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1941, by States and uses

[Commercial unless otherwise indicated]

State	Sand							
	Glass		Molding		Building			
					Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	-----	-----	96,446	$62,541	288,811	$209,092	24,450	$10,078
Alaska	-----	-----	-----	-----	-----	-----	-----	-----
Arizona	-----	-----	-----	-----	63,227	45,179	38,304	24,110
Arkansas	(1)	(1)	(1)	(1)	275,524	152,830	98	73
California	134,194	$483,643	87,666	232,488	5,601,255	2,885,751	(1)	(1)
Colorado	-----	-----	(1)	(1)	308,288	151,638	(1)	(1)
Connecticut	-----	-----	(1)	(1)	605,229	285,633	-----	-----
Delaware	-----	-----	3,887	1,751	68,476	45,364	-----	-----
Florida	-----	-----	-----	-----	913,939	565,696	1,398	273
Georgia	15,220	12,176	1,937	2,574	198,878	73,036	1,475	830
Idaho	-----	-----	-----	-----	52,464	26,962	4,486	3,812
Illinois	(1)	(1)	1,098,227	1,210,778	2,744,834	1,320,913	2,638	500
Indiana	(1)	(1)	266,493	199,845	1,745,707	701,073	-----	-----
Iowa	-----	-----	(1)	(1)	563,637	283,849	97	63
Kansas	-----	-----	1,500	600	790,225	367,475	25,393	5,088
Kentucky	-----	-----	9,033	18,161	179,500	125,160	(1)	(1)
Louisiana	-----	-----	-----	-----	516,523	170,235	98	73
Maine	-----	-----	-----	-----	57,920	24,733	1,830	329
Maryland	24,000	38,400	-----	-----	875,505	575,621	-----	-----
Massachusetts	-----	-----	(1)	(1)	1,641,282	819,459	2,512	198
Michigan	(1)	(1)	1,729,159	624,824	1,760,134	681,356	14,774	3,143
Minnesota	(1)	(1)	21,035	27,163	866,611	321,517	1,871,079	87,390
Mississippi	-----	-----	-----	-----	52,783	16,007	(1)	(1)
Missouri	(1)	(1)	81,086	79,778	1,491,397	785,150	70	25
Montana	5,025	5,418	-----	-----	46,314	38,744	6,724	8,852
Nebraska	-----	-----	-----	-----	450,773	160,109	7,864	6,599
Nevada	(1)	(1)	15,434	32,207	20,323	14,870	13,825	21,705
New Hampshire	-----	-----	-----	-----	(1)	(1)	217	38
New Jersey	296,467	403,346	1,254,861	1,950,840	1,555,550	722,298	-----	-----
New Mexico	-----	-----	-----	-----	(1)	(1)	31,005	21,452
New York	-----	-----	624,448	1,010,051	4,419,626	2,431,573	(1)	(1)
North Carolina	-----	-----	-----	-----	252,433	74,148	227,148	57,106
North Dakota	-----	-----	-----	-----	31,620	17,490	70	25
Ohio	(1)	(1)	953,586	1,559,677	2,325,082	1,454,560	3,522	1,180
Oklahoma	80,437	128,699	(1)	(1)	303,598	159,193	233	83
Oregon	-----	-----	-----	-----	222,621	181,789	414	455
Pennsylvania	(1)	(1)	433,853	669,450	2,564,736	2,183,062	725	1,100
Puerto Rico	-----	-----	-----	-----	-----	-----	(1)	(1)
Rhode Island	-----	-----	(1)	(1)	174,171	83,656	1,500	2,250
South Carolina	-----	-----	-----	-----	293,924	131,005	266,771	124,249
South Dakota	-----	-----	-----	-----	47,824	20,435	18,684	1,224
Tennessee	(1)	(1)	114,519	216,236	459,171	354,596	16,189	11,448
Texas	(1)	(1)	(1)	(1)	1,468,613	829,543	147,162	64,494
Utah	-----	-----	(1)	(1)	223,407	99,973	9,700	7,152
Vermont	-----	-----	-----	-----	(1)	(1)	5,331	3,808
Virginia	(1)	(1)	23,750	21,557	1,151,569	850,185	40,158	1,592
Washington	-----	-----	(1)	(1)	803,907	422,140	19,747	19,925
West Virginia	(1)	(1)	(1)	(1)	344,274	351,738	-----	-----
Wisconsin	-----	-----	159,729	138,694	1,254,711	430,033	77,498	49,834
Wyoming	-----	-----	-----	-----	12,102	7,881	4,984	4,293
Undistributed [2]	2,919,768	5,041,847	269,432	353,510	76,233	45,628	2,901,000	1,253,000
	3,475,111	6,113,529	7,246,081	8,412,725	40,164,731	21,698,378	5,789,000	1,797,000

See footnotes at end of table

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1941, by States and uses—Continued

State	Sand—Continued							
	Paving				Grinding and polishing [3]		Fire or furnace	
	Commercial		Government-and-contractor					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	484,170	$233,310	13,210	$1,690	(1)	(1)		
Alaska			10,875	150				
Arizona	27,837	17,434	5,378	2,275				
Arkansas	234,980	110,304	1,846	797			(1)	(1)
California	2,620,958	1,211,480	(1)	(1)	34,259	$54,266	1,000	$1,000
Colorado	25,034	14,576	(1)	(1)	1,916	2,081		
Connecticut	229,991	128,894	411,796	29,414				
Delaware	15,300	9,180			5,482	10,849		
Florida	224,148	136,382	525	432				
Georgia	277,581	132,111	1,427	1,194	12,594	16,809		
Idaho	24,131	17,112	88,894	38,261				
Illinois	1,061,569	483,614	16,029	12,134	(1)	(1)	56,548	60,956
Indiana	1,260,918	699,935	378	323			120,000	40,000
Iowa	287,125	124,124	5,665	526	(1)	(1)		
Kansas	677,410	293,964	242,896	91,245	564	388		
Kentucky	546,352	344,273	(1)	(1)				
Louisiana	446,618	263,566	245	182	(1)	(1)		
Maine	10,726	2,577	111,845	24,551			1,300	500
Maryland	(1)	(1)			(1)	(1)	(1)	(1)
Massachusetts	509,975	207,283	110,351	18,446	1,140	5,130		
Michigan	1,634,059	734,349	194,119	41,168	(1)	(1)		
Minnesota	282,110	166,644	148,409	27,719	(1)	(1)	(1)	(1)
Mississippi	457,264	189,470	(1)	(1)	1,259	615		
Missouri	526,883	279,692	14,412	10,023	(1)	(1)	(1)	(1)
Montana	15,652	8,354	4,576	4,256				
Nebraska	730,963	338,131	700	250	576	230		
Nevada	32,523	33,878	4,658	3,583	1,379	3,448		
New Hampshire	42,190	20,327	478,471	35,248				
New Jersey	1,326,648	600,480	542	38	110,596	224,146	35,707	42,341
New Mexico			119,805	64,656				
New York	3,082,806	1,665,993	(1)	(1)			(1)	(1)
North Carolina	811,941	290,381	1,322,428	230,113				
North Dakota	17,922	5,720	280	200				
Ohio	1,662,985	1,030,338	2,367	1,445	(1)	(1)	(1)	(1)
Oklahoma	156,727	74,779	62,771	13,129				
Oregon	132,406	87,686	36,573	29,036				
Pennsylvania	1,802,150	1,580,208	140	140	(1)	(1)	41,893	60,912
Puerto Rico			(1)	(1)				
Rhode Island	20,592	8,281	94,386	69,793				
South Carolina	81,258	25,481	189,164	93,720	(1)	(1)		
South Dakota	(1)	(1)	116,777	69,998				
Tennessee	772,442	540,062	81,772	14,835	17,613	24,555	145	159
Texas	1,305,914	752,660	238,640	180,611	6,510	10,044	(1)	(1)
Utah	224,812	83,380	12,420	4,790				
Vermont	(1)	(1)	5,331	3,808	(1)	(1)		
Virginia	418,019	214,392	397,349	52,010	(1)	(1)		
Washington	205,689	109,144	139,678	58,171				
West Virginia	338,335	288,024	22,271	16,361	(1)	(1)		
Wisconsin	273,708	144,977	323,471	106,937	(1)	(1)		
Wyoming	800	400	3,034	1,090				
Undistributed [2]	1,691,662	1,131,028	7,840,000	2,658,000	807,926	1,036,405	69,210	151,372
	27,013,283	14,834,378	12,870,000	4,013,000	1,001,814	1,388,966	325,803	357,240

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1941, by States and uses—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast [4]		Other [5]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)						
Alaska								
Arizona			(1)	(1)				
Arkansas	(1)	(1)	(1)	(1)	(1)	(1)	4,312	$308
California	35,097	$16,796	3,844	$11,259	44,064	$14,769	199,097	184,814
Colorado	36,209	31,373	92	467			30,123	11,057
Connecticut			2,390	2,180			(1)	(1)
Delaware	58,870	19,313	1,116	2,512			3,420	2,052
Florida	(1)	(1)					(1)	(1)
Georgia	11,536	4,628	1,757	5,271			85,950	28,263
Idaho	630	400					2,682	1,826
Illinois	82,450	42,820	(1)	(1)	(1)	(1)	(1)	(1)
Indiana	85,731	33,594			22,340	6,111	51,970	13,416
Iowa	39,652	23,308	4,063	14,702	2,158	854	18,763	8,225
Kansas	79,493	41,346	(1)	(1)	4,705	1,943	17,556	5,864
Kentucky	40,159	28,478					(1)	(1)
Louisiana	22,202	5,017			74,933	21,304	(1)	(1)
Maine	(1)	(1)			(1)	(1)	(1)	(1)
Maryland	(1)	(1)	(1)	(1)			(1)	(1)
Massachusetts	4,500	1,125			(1)	(1)	55,079	11,503
Michigan	(1)	(1)			266,506	44,484	73,925	34,208
Minnesota	(1)	(1)	966	2,636	354,062	74,327	40,129	8,684
Mississippi	14,766	6,257					5,104	2,509
Missouri	25,863	24,024	(1)	(1)	(1)	(1)	(1)	(1)
Montana							175,825	22,038
Nebraska	188,095	63,253			6,041	2,356	29,227	6,283
Nevada							(1)	(1)
New Hampshire								
New Jersey	30,336	16,349	51,648	79,315			(1)	(1)
New Mexico	(1)	(1)						
New York	46,190	21,378	(1)	(1)	(1)	(1)	70,589	33,463
North Carolina	51,861	37,437	(1)	(1)			28,598	8,010
North Dakota								
Ohio	68,390	50,162	6,631	10,700	53,403	11,072	147,425	167,884
Oklahoma	(1)	(1)					17,888	7,689
Oregon	17,717	3,901			32,162	12,407	9,754	2,787
Pennsylvania	327,985	354,943	(1)	(1)			228,160	302,120
Puerto Rico								
Rhode Island	(1)	(1)					(1)	(1)
South Carolina	23,684	7,192	(1)	(1)	12,675	1,825	15,905	7,308
South Dakota							1,872	1,488
Tennessee	23,311	16,554	(1)	(1)			43,233	23,548
Texas	42,350	22,030	(1)	(1)	98,920	36,613	117,897	38,642
Utah	(1)	(1)	500	500			(1)	(1)
Vermont	(1)	(1)					(1)	(1)
Virginia	78,324	32,117					76,370	45,485
Washington	(1)	(1)			(1)	(1)	47,253	13,893
West Virginia	298,920	269,035			11,500	6,000	(1)	(1)
Wisconsin	(1)	(1)	(1)	(1)	40,326	12,048	26,816	6,101
Wyoming							(1)	(1)
Undistributed [2]	288,461	139,603	190,959	194,565	610,540	199,068	397,682	505,966
	2,022,782	1,312,433	263,966	324,107	1,634,335	445,181	2,022,604	1,455,384

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1941, by States and uses—Continued

State	Gravel							
	Building				Paving			
	Commercial		Government-and-contractor		Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	362,283	$371,716	33,378	$7,649	907,926	$577,716	73,156	$22,069
Alaska	-----	-----	-----	-----	(1)	(1)	520,122	86,966
Arizona	75,245	59,687	86,817	52,746	127,355	59,763	219,220	65,950
Arkansas	375,679	320,537	56,586	8,153	371.426	209,648	1,260,529	512,062
California	6,581,234	3,753,562	(1)	(1)	3,379,252	1,936,490	(1)	(1)
Colorado	(1)	(1)	(1)	(1)	186,488	123,664	(1)	(1)
Connecticut	628,214	389,020	-----	-----	131,170	68,810	-----	-----
Delaware	11,808	11,833	-----	-----	-----	-----	-----	-----
Florida	(1)	(1)	245	91	53,466	58,471	1,301	657
Georgia	-----	-----	1,015	661	-----	-----	6,141	5,595
Idaho	70,901	37,743	37,792	12,348	153,469	97,876	1,994,191	540,859
Illinois	2,985,019	1,579,731	216	108	1,711,802	762,960	534,819	190,346
Indiana	1,294,900	784,050	45,482	6,464	2,167,262	1,318,556	498,031	150,348
Iowa	406,450	351,546	1,829	246	1,051,900	360,990	3,448,330	309,047
Kansas	221,575	120,851	14,777	3,283	309,569	183,426	534,792	167,992
Kentucky	233,562	184,340	(1)	(1)	545,577	387,043	(1)	(1)
Louisiana	1,028,031	720,722	245	91	1,407,270	1,101,151	22,091	2,045
Maine	59,422	35,385	64	69	172,536	70,704	3,236,439	700,156
Maryland	(1)	(1)	-----	-----	(1)	(1)	159,819	11,397
Massachusetts	1,357,537	1,056,930	-----	-----	754,745	370,179	388,869	35,499
Michigan	2,101,135	1,196.559	284,260	46,688	2,430,213	1,114,651	4,061,027	1,157,224
Minnesota	529,968	566,717	227,013	80,197	676,623	361,349	6,823,244	486,498
Mississippi	148,573	66,635	(1)	(1)	1,124,735	627,347	(1)	(1)
Missouri	1,448,353	818,067	65.422	13,115	629,671	371,920	615,774	271,457
Montana	123,535	92,185	10,749	14,038	435,565	242,511	2,555,177	1,126,417
Nebraska	266,364	167,882	23,834	8,442	1,031,936	324,158	426,751	186,596
Nevada	(1)	(1)	7.798	15,468	30,760	11,344	1,883,234	536,012
New Hampshire	(1)	(1)	11,269	804	(1)	(1)	1,122,343	96,265
New Jersey	735,616	492,296	-----	-----	454,273	276.470	10.193	728
New Mexico	(1)	(1)	57,867	66,408	-----	-----	1,739,910	1,117,297
New York	3,524,752	2.657,021	(1)	(1)	2,578,382	2,146,409	(1)	(1)
North Carolina	473,534	511,872	12,158	5,196	589,231	657,344	145,421	30,250
North Dakota	40,224	36,707	140	50	54,733	31,179	2,180,117	87,877
Ohio	1,879,106	1,319,771	17,330	2,751	3,023,893	1,928,436	498,109	70,440
Oklahoma	81,647	53,882	245	91	197,680	133,110	582,821	33,172
Oregon	670,058	403,941	9,594	739	805,689	471,173	1,902,144	901,044
Pennsylvania	2,120,100	1,776,787	400	1,150	1,910,073	1,558,415	113,053	24,010
Puerto Rico	-----	-----	-----	-----	-----	-----	(1)	(1)
Rhode Island	164,796	111,824	2,500	3,750	36,314	7,482	82,728	64,319
South Carolina	103,546	97,158	245	91	102,946	96,075	1,091	545
South Dakota	12,349	8,682	49,141	3,241	37,882	8,109	2,007,917	378,138
Tennessee	337,838	264,601	42,430	8,334	1,542,164	1,017,528	1,182,045	207,428
Texas	2,275,924	1,673,674	113,804	38,444	2,473,377	1,867,323	2,329,012	439,043
Utah	226,526	104,261	17,704	11,223	396,010	154,962	1,344,743	393,820
Vermont	-----	-----	700	500	(1)	(1)	590,556	119,033
Virginia	1,249,325	1,703,145	-----	-----	652,697	666,987	444.484	105,275
Washington	841,451	505,130	106,704	65,855	634,067	367,506	1,744,960	697,252
West Virginia	304,068	306,309	-----	-----	477,980	378,877	123,086	50,851
Wisconsin	956,402	441,261	173,449	109,321	954,230	418,567	3,481,301	1,154,708
Wyoming	17,821	12,527	8,698	6,034	37,432	34,543	876,153	438,136
Undistributed [2]	1,575,352	1,563,241	7,257,000	3,203,000	1,560,535	1,663,676	27,950,000	9,909,000
	37,900,243	26,729,788	8,779,000	3,797,000	38,310,304	24,624,898	79,715,000	22,893,000

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1941, by States and uses—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast [6]		Other [7]		Total commercial		Total Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	98, 585	$44, 933	4, 620	$2, 772	2, 284, 801	$1, 514, 971	144, 194	$41, 486
Alaska	-----	-----	-----	-----	(1)	(1)	530. 997	87, 116
Arizona	(1)	(1)	(1)	(1)	353, 170	190. 393	349, 719	145, 061
Arkansas	870. 894	315, 250	5, 014	819	2, 268, 847	1, 277, 222	1, 319, 059	521, 065
California	512, 053	69, 599	383, 636	182, 849	19, 617, 609	10, 988, 766	(1)	(1)
Colorado	5, 302	3, 203	(1)	(1)	809. 270	528, 116	(1)	(1)
Connecticut	29, 216	29, 216	35, 221	4, 835	1, 665. 181	912, 488	411, 796	29, 414
Delaware	-----	-----	-----	-----	168. 359	10?, 854	-----	-----
Florida	(1)	(1)	-----	-----	1, 458, 807	948, 527	3. 469	1, 453
Georgia	-----	-----	-----	-----	605, 453	274, 868	10, 058	8, 280
Idaho	405. 912	91, 168	11. 200	14. 500	721, 389	287. 587	2, 125, 363	595, 280
Illinois	1, 933. 312	734. 703	62, 132	27. 460	13. 335, 283	8, 068. 082	553. 702	203. 088
Indiana	1, 225, 626	571. 835	(1)	(1)	8, 354, 085	4, 403. 517	543, 891	157, 135
Iowa	348, 418	150, 089	13, 430	19, 804	2, 815, 781	1. 418, 859	3, 455, 921	309, 882
Kansas	(1)	(1)	4, 318	3, 367	2, 110, 063	1, 021. 312	817, 858	267, 608
Kentucky	(1)	(1)	-----	-----	1, 654, 183	1, 124, 705	(1)	(1)
Louisiana	170, 563	94, 036	(1)	(1)	3, 677, 461	2, 383. 706	22, 679	2, 391
Maine	148, 510	53, 132	80, 222	20, 031	541, 478	210, 797	3, 350, 178	725, 105
Maryland	-----	-----	3, 444	3, 000	5, 007. 626	4, 435, 453	159. 819	11, 397
Massachusetts	(1)	(1)	(1)	(1)	4, 849, 270	2, 620, 414	501, 732	54, 143
Michigan	669, 929	214, 890	38, 924	12, 862	11, 052, 035	4, 942, 113	4, 554, 180	1, 248, 223
Minnesota	1, 295, 616	433. 176	344, 289	39, 479	4, 447, 324	2, 023, 730	9, 069, 745	681, 804
Mississippi	385, 835	108, 361	2, 510	1, 303	2, 192, 829	1, 018. 504	(1)	(1)
Missouri	143, 964	81, 925	(1)	(1)	4, 706, 225	2, 925, 466	695, 678	294, 620
Montana	1, 133, 973	272, 475	193, 570	36, 624	2, 129, 459	718, 349	2, 577, 226	1, 153. 563
Nebraska	10, 414	6, 625	3. 163	2, 202	2, 717, 552	1, 071, 179	459, 149	201. 887
Nevada	52, 762	5, 532	(1)	(1)	260, 630	317, 953	1, 909, 515	576, 768
New Hampshire	-----	-----	(1)	(1)	281, 774	204, 183	1, 612, 300	132, 355
New Jersey	-----	-----	(1)	(1)	5, 954, 134	4, 896, 273	10, 735	766
New Mexico	-----	-----	-----	-----	(1)	(1)	1, 948, 587	1, 269, 813
New York	18, 423	18, 657	522, 065	94, 225	14, 923, 149	10, 096, 875	(1)	(1)
North Carolina	35, 219	24, 649	(1)	(1)	2, 766, 142	2, 022, 500	1, 707, 155	322, 665
North Dakota	268, 026	55, 161	42, 907	4, 455	455, 432	150, 712	2, 180, 607	88, 152
Ohio	1, 289, 905	598, 854	187, 803	206, 469	11, 951, 817	9, 154, 542	521, 328	75, 816
Oklahoma	-----	-----	1, 411	5, 930	867, 918	581, 389	646, 070	46, 475
Oregon	82, 960	46, 682	46, 303	17, 830	2, 019, 670	1, 228, 196	1, 948, 725	931, 274
Pennsylvania	-----	-----	101, 379	74, 251	10, 401, 622	9, 910, 498	114, 318	26, 400
Puerto Rico	-----	-----	-----	-----	-----	-----	(1)	(1)
Rhode Island	-----	-----	(1)	(1)	468, 175	319, 111	181, 114	140, 112
South Carolina	13, 345	2, 301	171	189	668, 454	392, 864	457, 271	218, 605
South Dakota	287, 043	54, 907	(1)	(1)	434, 540	107, 165	2, 192, 519	452, 601
Tennessee	140, 537	85, 763	18, 411	15, 334	3, 489, 250	2, 587, 791	1, 822, 436	242, 045
Texas	1, 337, 678	520, 738	127, 922	76, 089	9, 305, 694	5, 958, 685	2, 828, 618	722, 592
Utah	249, 159	50, 931	(1)	(1)	1, 375, 458	518, 386	1, 384, 567	416, 985
Vermont	(1)	(1)	-----	-----	(1)	(1)	601, 918	127, 149
Virginia	-----	-----	22, 886	25, 481	3, 711, 202	3, 611, 773	881, 991	158, 877
Washington	716, 980	75, 926	274, 471	107, 103	3, 572, 196	1, 635, 631	2, 011, 089	841, 203
West Virginia	22, 444	10, 924	(1)	(1)	2, 588, 250	3, 109, 427	145, 357	76, 212
Wisconsin	1, 118, 231	243, 280	336, 315	78, 176	5, 207, 518	1, 977, 239	4, 055, 719	1, 420, 800
Wyoming	1, 008, 439	325, 344	(1)	(1)	1, 110, 794	391, 380	892. 869	449, 553
Undistributed [2]	272, 902	62, 035	1, 005, 498	476, 167	199, 108	122, 362	45, 948, 000	17, 023, 000
	16, 302, 175	5, 456, 300	3, 873, 235	1, 553, 606	181, 556, 467	114, 706, 913	107, 159, 000	32, 500, 000

[1] Included under "Undistributed."
[2] Includes, in addition to items entered as "1" sand and gravel produced on W. P. A. projects.
[3] Includes 371,049 tons of blast sand valued at $912,626.
[4] Includes 37,911 tons of ballast sand valued at $5,676, produced by railroads for their own use.
[5] Includes 351,537 tons of sand valued at $36,737, used by railroads for fills and similar purposes.
[6] Includes 7,536,591 tons of ballast gravel valued at $1,506,12?, produced by railroads for their own use.
[7] Includes 1,157,557 tons of gravel valued at $128,993, used by railroads for fills and similar purposes.

Location of plants.—Figure 2 shows the location of all pits reported to the Bureau of Mines as producing sand or gravel, or both, used in any kind of construction in 1940. Each dot represents an active pit, regardless of the volume of material produced. Inasmuch as 1940 was a fairly active year in the building trades and new pits can be opened without difficulty, the map may be regarded as a reasonably accurate index of commercial sources of supply. Sand and gravel pits are numerous and widely scattered. They are abundant in the glacial deposits of the northeastern quarter of the United States but are scattered south of the Ohio and Missouri Rivers, which mark the southern limits of the terminal moraines. Many deposits occur on the Pacific coastal plain. River beds and their banks are important sources of supply. The concentration of pits along the Mississippi and Ohio Rivers is noteworthy. The Arkansas, Missouri, and Willamette Rivers are not shown on the map, although their courses may be traced by the pits along their channels.

The extent of reserves of sand and gravel can be judged only in part from this map, for many large undeveloped deposits are situated in sparsely settled territory. On the other hand, the large number and close proximity of pits in the populous industrial areas of the Northeastern, Middle Western, and Pacific Coast States indicate intensive development of sand and gravel deposits, and not necessarily a more abundant supply.

Government-and-contractor production.—The quantity of sand and gravel reported by State government agencies for 1941 increased 7 percent over that reported for 1940 and represented 37 percent of the total Government-and-contractor output during 1941; of this quantity, 54 percent was produced by contractors. Counties reported 21 percent and municipalities 1 percent of the production. The remaining 41 percent was produced largely by Federal agencies, including the Forest Service, National Park Service, Bureau of Public Roads, Bureau of Reclamation, Soil Conservation Service, United States Engineer Office, and Work Projects Administration.

Average values of the materials were higher than in 1940, except the output by or for counties. Other details are shown in the following tables.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1937–41, by uses

Year	Sand				Gravel				Total Government-and-contractor sand and gravel	
	Building		Paving		Building		Paving			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	1, 540, 280	$595, 953	4, 704, 764	$1,157,162	2, 961, 360	$1,396,202	55, 111, 541	$15,209,362	64, 317, 945	$18,358,679
1938	2, 157, 501	890, 224	6, 623, 073	1, 373, 556	7, 299, 822	2, 454, 783	59, 480, 051	16, 188, 406	75, 560, 447	20, 906, 969
1939	5, 815, 000	2, 255, 000	9, 114, 000	2, 767, 000	10,896,000	5, 586, 000	81, 790, 000	24, 275, 000	107, 615, 000	34, 883, 000
1940	5, 149, 000	2, 039, 000	9, 595, 000	2, 767, 000	9, 866, 000	4, 922, 000	82, 442, 000	22, 690, 000	107, 052, 000	32, 418, 000
1941	5, 789, 000	1, 797, 000	12,876,000	4, 013, 000	8, 779, 000	3, 797, 000	79, 715, 000	22, 893, 000	107, 159, 000	32, 500, 000

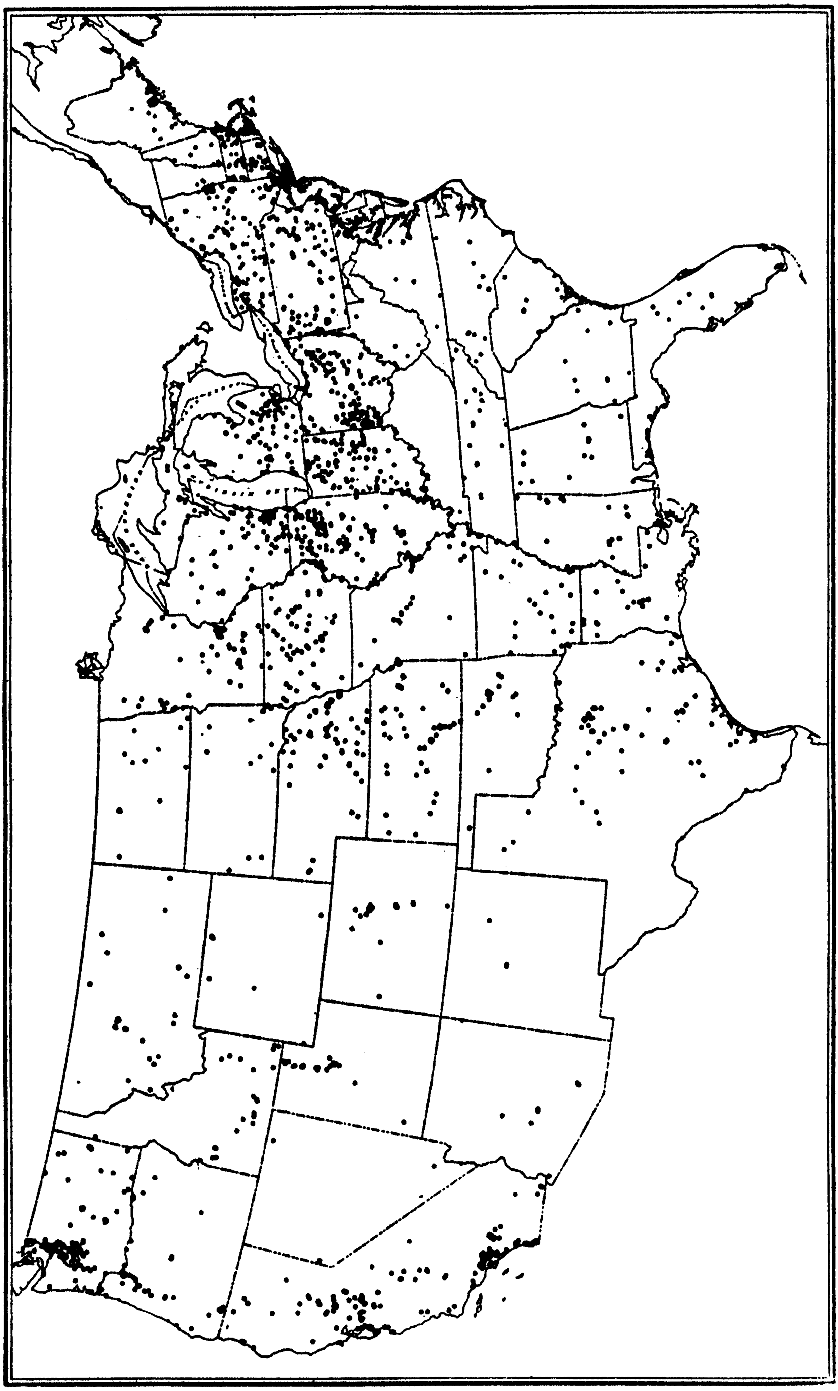

FIGURE 2.—Location of sand and gravel plants in the United States.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1938–41, by types of producers

Type of producer	1938		1939		1940		1941	
	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton
Construction and maintenance crews	44,745,693	$0.21	71,934,000	$0.29	78,615,000	$0.28	66,234,000	$0.27
Contractors	30,814,754	.37	35,681,000	.39	28,437,000	.37	40,925,000	.36
	75,560,447	.28	107,615,000	.32	107,052,000	.30	107,159,000	.30
States	38,434,738	.31	35,770,000	.29	36,657,000	.26	39,177,000	.26
Counties	23,892,718	.19	16,588,000	.24	21,685,000	.22	22,772,000	.20
Municipalities	2,232,786	.33	2,093,000	.26	1,923,000	.28	1,637,000	.29
Other agencies	11,000,205	.34	53,164,000	.38	46,787,000	.38	43,573,000	.40
	75,560,447	.28	107,615,000	.32	107,052,000	.30	107,159,000	.30

METHOD OF TRANSPORTATION

Sand and gravel are conveyed from pit to destination by truck, railway, or waterway. In 1934, 57.4 percent of the total shipment was by rail; a steady decline in rail shipments had been noted from that year until the recovery recorded in 1941.

Sand and gravel sold or used by commercial producers in the United States, 1940–41, by methods of transportation [1]

Method of transportation	1940		1941	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck	54,063,146	45.8	74,452,542	44.9
Rail	45,254,984	38.4	69,225,395	41.7
Waterway	18,600,060	15.8	22,201,899	13.4
Total reported	117,918,190	100.0	165,879,836	100.0
Percent of total commercial production covered		89.8		91.0

[1] For practical purposes the entire output of Government-and-contractor operations commonly is moved by truck. Including Government-and-contractor production, sand and gravel moved as follows—1940: Truck 72 percent, rail 20 percent, and waterway 8 percent; 1941: Truck 67 percent, rail 25 percent, and waterway 8 percent.

DEGREE OF PREPARATION

Specifications for sand and gravel are becoming increasingly rigid. Although in many regions nature has sorted its materials remarkably well, relatively few deposits supply products that will satisfy market requirements without screening or washing. In 1941, 88 percent of all commercial production was processed in some way, and the remainder was sold as bank-run material. On the other hand, only 21 percent of the Government-and-contractor production was processed. This accounts largely for the low average value per ton of the Government-and-contractor output compared with commercial production.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1940–41, by commercial and Government-and-contractor operations

	1940			1941		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	115,425,213	88	$0.63	159,784,239	88	$0.67
Unprepared	15,831,054	12	.36	21,772,228	12	.33
	131,256,267	100	.60	181,556,467	100	.63
Government-and-contractor operations:						
Prepared	35,633,000	33	.43	22,311,000	21	.49
Unprepared	71,419,000	67	.24	84,848,000	79	.25
	107,052,000	100	.30	107,159,000	100	.30
Grand total	238,308,000	----------	.46	288,715,000	----------	.51

SIZE OF PLANTS

More than half of the commercial sand and gravel plants of the United States are in a size group that produces less than 25,000 tons annually, but this large group contributed only 8.1 percent of the total production in 1940. Medium-size plants furnish the bulk of the output. In 1940, 61.5 percent of the total came from plants having an annual production between 25,000 and 300,000 tons. Details of output, by size groups, for 1939 and 1940 are given in the following table.

Comparison of number and output of commercial sand and gravel plants in the United States, 1939–40, by size groups [1]

Size group in short tons	1939				1940			
	Plants [2]		Production		Plants [2]		Production	
	Number	Percent of total	Short tons	Percent of total	Number	Percent of total	Short tons	Percent of total
Less than 25,000	1,133	54.5	9,398,000	8.4	1,224	54.7	10,218,000	8.1
25,000 and less than 50,000	365	17.5	13,011,000	11.6	379	17.0	13,538,000	10.8
50,000 and less than 100,000	286	13.7	20,431,000	18.2	310	13.8	21,901,000	17.5
100,000 and less than 200,000	186	8.9	25,686,000	22.8	204	9.1	28,525,000	22.8
200,000 and less than 300,000	50	2.4	12,077,000	10.7	54	2.4	12,981,000	10.4
300,000 and less than 400,000	26	1.3	9,086,000	8.1	25	1.1	8,546,000	6.8
400,000 and less than 500,000	11	.5	4,948,000	4.4	11	.5	4,843,000	3.9
500,000 and less than 600,000	11	.5	4,884,000	4.3	13	.6	7,007,000	5.6
600,000 and less than 700,000	3	.2	2,077,000	1.8	5	.2	3,181,000	2.5
700,000 and less than 800,000					3	.1	2,230,000	1.8
800,000 and less than 900,000	4	.2	3,289,000	2.9	2	.1	1,646,000	1.3
900,000 and less than 1,000,000	-----	-----	-----	-----	4	.2	3,712,000	3.0
1,000,000 and over	6	.3	7,666,000	6.8	5	.2	6,855,000	5.5
	2,081	100.0	112,553,000	100.0	2,239	100.0	125,283,000	100.0

[1] Plants operated by or for States, counties, and municipalities are not included; also not included are approximately 194 railroad plants with an output of 5,840,000 tons of sand and gravel in 1939 and 187 plants with an output of 5,973,000 tons in 1940.
[2] May include a few companies operating more than 1 plant but not submitting separate reports for individual plants.

PRINCIPAL TRENDS

Sand and gravel for construction.—Markets for sand and gravel depend primarily on the construction industries. Figure 3 shows the correlation between highway construction and sales of gravel, as well as the relation of sand output to construction activity in general. Construction of numerous military establishments during 1941 created a strong market for building sand and gravel, which was supplemented by the demands of active private construction and extensive highway work. The magnitude of the 1942 market is problematical because highway building, except that of military importance, has been curtailed drastically, and the program of private building has been reduced greatly. Direct military construction and all types of building that are or will be authorized because of their

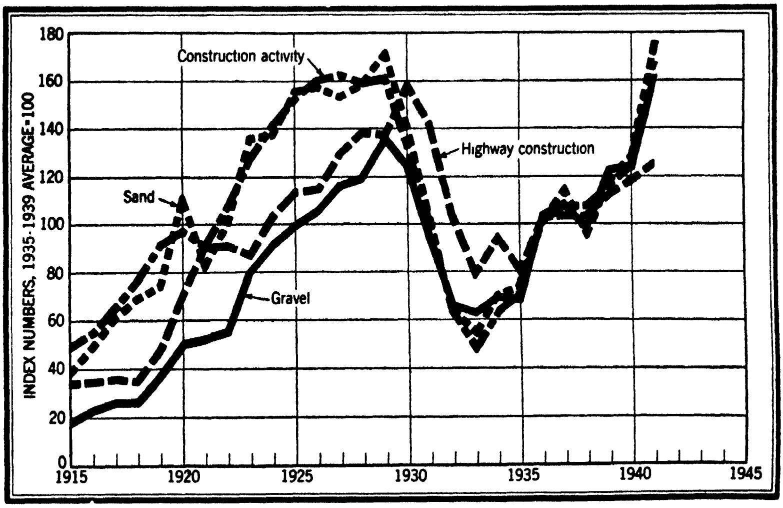

FIGURE 3.—Comparison of production of sand and gravel with highway construction (including maintenance) and construction activity (including maintenance and work relief) in the United States, 1915–41. Data on highway construction and construction activity from Bureau of Foreign and Domestic Commerce.

indirect promotion of the military program will continue at a high level and may counteract the decline in nonmilitary construction.

Industrial sands.—Sand has important uses in manufacturing industries, and the volume of sales fluctuates in consonance with industrial activity. With foundries working at virtually 100 percent of capacity, the demand for molding and fire or furnace sand has been unparalleled. The glass industry has been active because of the movement to substitute glass for metals and the high level of carloadings is indicated by a growing demand for engine sand. Increased industrial activity in various fields has promoted a wider use of grinding and polishing sand. Figure 4 shows graphically the history of production of industrial sands since 1916.

As indicated in figure 5, sales of molding sand follow in general the trend of industrial production. They also show marked correlation with the number of automobiles manufactured during recent years, but such correlation will cease in 1942.

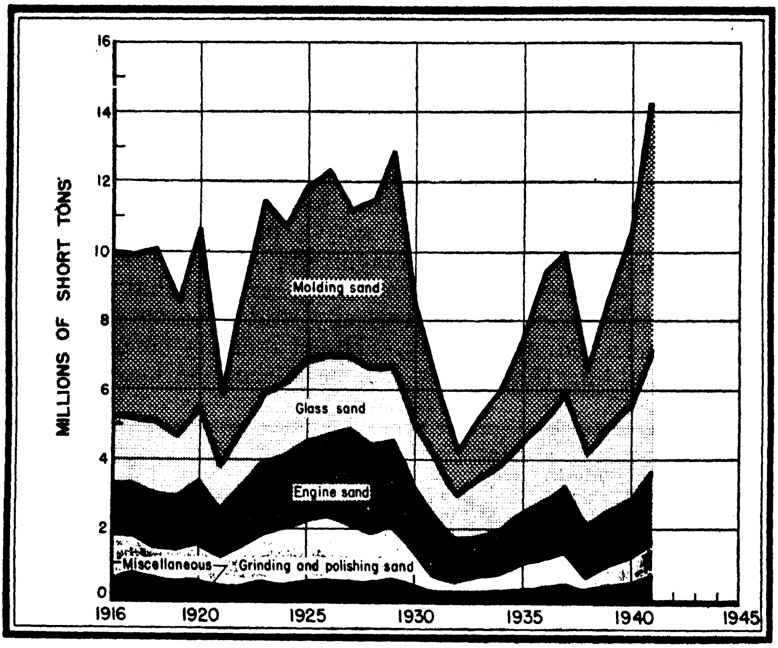

FIGURE 4.—Production of industrial sands in the United States, 1916–41.

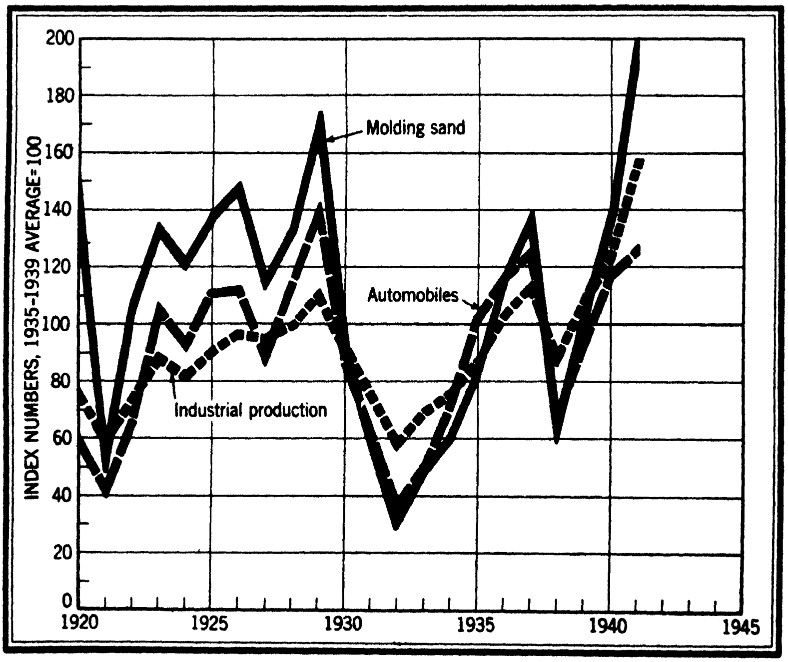

FIGURE 5.—Trends in sales of molding sand compared with automobiles manufactured and industrial production, 1920–41. Statistics on automobiles from Bureau of the Census. Index of industrial production from Federal Reserve Board.

EMPLOYMENT AND PRODUCTIVITY [2]

Data on employment and output per man in the sand and gravel industry have been recorded since 1933.[3] The figures for 1940 that follow are based upon operations reporting more than three-fourths of the total commercial production. Data for 1941 are not yet available.

The number of men employed was 6 percent higher in 1940 than in 1939, the average number of days employed increased 1 percent, and the average length of shift was virtually the same as in 1939. The average productivity was 3.3 short tons per man per hour, which is the same as the average for the 4 years 1936–39.

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1935–40 [1]

Year	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel (short tons)	Average per man (short tons)		
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
1935	11,926	197	2,351,453	8.3	19,578,368	60,826,691	25.9	3.1	75.4
1936	16,127	207	3,332,532	8.6	28,672,615	95,219,468	28.6	3.3	83.8
1937	16,062	215	3,458,994	8.6	29,754,746	97,113,001	28.1	3.3	81.8
1938	14,971	201	3,001,796	8.5	25,578,807	81,742,896	27.2	3.2	81.1
1939	15,617	214	3,335,321	8.4	28,054,960	96,755,364	29.0	3.5	81.7
1940	16,595	217	3,596,886	8.4	30,263,744	101,143,305	28.1	3.3	77.1

[1] Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

Productivity data by regions for 1940 are summarized in the accompanying table. The most notable changes to be observed in comparison with 1939 are the smaller output per man per hour in New York and in the Wyoming-Colorado-New Mexico-Utah-Arizona area and the increased productivity in the South Carolina-Georgia-Alabama-Florida-Mississippi area. The highest productivity (5.4 tons per man per hour) was attained in the Michigan-Wisconsin area.

[2] Statistics on employment and productivity compiled by Elva T. Shuey from records of the employment statistics section, Bureau of Mines.

[3] See Minerals Yearbook 1935, pp. 941–943; 1936, pp. 843–845; 1940, Review of 1939, pp. 1218–1221; and Review of 1940, pp 1191–1193

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States in 1940, by regions [1]

Region	Employment: Average number of men	Employment: Time employed: Average number of days	Employment: Time employed: Total man-shifts	Employment: Time employed: Man-hours: Average per man per day	Employment: Time employed: Man-hours: Total	Production: Commercial sand and gravel (short tons)	Production: Average per man (short tons): Per shift	Production: Average per man (short tons): Per hour	Percent of commercial industry represented
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	637	172	109,519	8.5	930,527	4,218,895	38.52	4.5	84.5
New York	1,313	214	281,613	8.1	2,293,227	8,839,080	31.39	3.9	66.8
Pennsylvania, New Jersey, and Delaware	2,328	251	583,303	8.5	4,961,574	12,464,809	21.37	2.5	92.7
West Virginia, Virginia, Maryland, and District of Columbia	1,018	234	238,671	8.3	1,988,051	3,643,561	15.27	1.8	51.5
South Carolina, Georgia, Alabama, Florida, and Mississippi	773	242	186,854	8.7	1,630,246	4,347,188	23.27	2.7	83.2
North Carolina, Kentucky, and Tennessee	793	239	189,659	8.6	1,627,278	3,367,470	17.76	2.1	77.6
Arkansas, Louisiana, and Texas	1,213	208	252,406	9.0	2,261,392	5,380,140	21.32	2.4	61.7
Ohio	1,502	245	368,255	8.4	3,091,009	7,452,901	20.24	2.4	82.3
Illinois and Indiana	1,632	211	343,821	8.3	2,860,729	13,472,265	49.18	4.7	84.9
Michigan and Wisconsin	1,128	188	212,048	8.6	1,814,194	9,773,703	46.09	5.4	79.3
North Dakota, South Dakota, and Minnesota	403	158	63,681	8.4	534,115	2,421,076	38.02	4.5	57.6
Nebraska and Iowa	703	184	129,198	9.4	1,214,179	4,309,467	33.36	3.5	75.9
Kansas, Missouri, and Oklahoma	864	194	167,973	8.0	1,347,369	4,318,630	25.71	3.2	77.1
Wyoming, Colorado, New Mexico, Utah, and Arizona	300	180	53,949	7.9	427,197	1,393,686	25.83	3.3	57.5
California and Nevada	1,321	230	303,214	8.0	2,410,957	12,164,123	40.12	5.0	91.9
Montana, Washington, Oregon, and Idaho	667	169	112,722	7.7	871,700	3,576,311	31.73	4.1	61.1
Total United States	16,595	217	3,596,886	8.4	30,263,744	101,143,305	28.12	3.3	77.1

[1] Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

PRICES

Prices for commercial sand and gravel were, in general, higher in 1941 than in 1940. The largest gains were in molding sand, which increased from $1.05 to $1.16 a ton, and in grinding and polishing sand, which increased from $1.07 to $1.39 a ton. The prices of filter sand and fire or furnace sand declined. The average price of total commercial gravel increased 5 cents a ton. Building gravel increased from 65 to 71 cents a ton and paving gravel from 59 to 64 cents. Railroad-ballast prices remained unchanged.

The average price of total Government-and-contractor sand and gravel remained unchanged. Building sand declined from 40 to 31 cents, but paving sand increased from 29 to 31 cents a ton. The same trends were apparent in gravel; that used for building declined, whereas that for paving rose.

NEW DEVELOPMENTS

New aggregate problems arise at each great dam built in the Far West. At Boulder Dam the problem was quantity production and storage; at Grand Coulee it was disposal of an excess of fine sand. At Shasta Dam just the reverse condition exists from that at Grand Coulee, because there is a dearth of fine sand. Ball mills and rod mills had to be installed to reduce the minus-3/16-inch sand to three finer sizes, namely, 4- to 28-, 28- to 60-, and 60- to 100-mesh. The various sizes of gravel and sand are blended in exact proportions as required. Gold is recovered as a byproduct of the sand.

The plant supplying the aggregate, situated near Redding, Calif., has a 1,200-ton-per-hour washing and screening plant. A unique feature is a 10-mile belt-conveyor system to carry aggregates to the dams. The belts travel 550 feet a minute, and the haulage cost is said to be only half as much as rail transportation.

A Pennsylvania gravel company reduces surplus gravel to sand sizes by means of a recently developed type of impact crusher. The size of the gravel and boulders is reduced by hurling them at high velocity against breaker plates. The method is said to be efficient. The impact crusher is employed at some plants simply to eliminate soft stone.

Research is being directed toward obtaining improved adhesion between aggregates and bituminous bonding materials, thus increasing the durability of road surfaces.

The Los Angeles abrasive-testing machine has been adapted to test extremely small and exceptionally large aggregates, as well as intermediate grades.

The Bureau of Mines has developed refinements in the purification of glass sands involving application of froth flotation, agglomeration, and attrition scrubbing to remove impurities.

The more-refined methods of treating sand include acid leaching to reduce the iron content to as low as 0.01 percent, fine grinding in air-swept tube mills controlled by "electric ears," and the use of bag-type dust collectors, not only to protect workers from pulmonary diseases but also to recover considerable quantities of extremely fine grained materials that are salable for use in soaps, scouring powders, and other abrasive products.

FOREIGN TRADE [4]

Because of intensified warfare and difficulties of transportation, imports of sand and gravel during 1941 were very small and were obtained chiefly from Canada. No glass sand was imported.

Exports of sand and gravel were not recorded separately in 1940 and 1941.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Sand and gravel imported for consumption in the United States, 1940–41, by classes and countries

Country	Glass sand [1]		Other sand [2]		Gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940								
North America: Canada			249,829	$78,088	175,140	$25,313	424,969	$103,401
Europe:								
Belgium	4,337	$8,722	336	750			4,673	9,472
Denmark			2,106	360			2,106	360
France			101	480			101	480
Netherlands			814	327			814	327
Norway			224	25			224	25
United Kingdom			10,754	10,250	418	373	11,172	10,623
Asia: Japan			(3)	9			(3)	9
Oceania: Australia			6	61			6	61
	4,337	8,722	264,170	90,350	175,558	25,686	444,065	124,758
1941 (Jan.-Sept.)								
North America: Canada			159,709	69,404	98,748	15,387	258,457	84,791
Europe: United Kingdom			6,518	3,820			6,518	3,820
Oceania: Australia			1	5			1	5
			166,228	73,229	98,748	15,387	264,976	88,616

[1] Classification reads "Sand containing 95 percent silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
[2] Classification reads "Sand, n. s. p. f."
[3] Less than 1 ton.

Sand and gravel exported from the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	67,141	$80,197	1940	(2)	(2)
1938	35,572	30,303	1941 (Jan.-Sept.)	(2)	(2)
1939 [1]	27,746	31,931			

[1] Classification reads "Gravel and building stone."
[2] Not separately classified.

BLAST-FURNACE SLAG

Continuing the policy inaugurated in 1938, the National Slag Association conducted a canvass of 30 companies (64 plants) that prepare blast-furnace slag for commercial use. The total output for 1941 was 14,678,266 short tons valued at $11,064,102. Of this total, 84 percent was air-cooled and screened, 5 percent air-cooled and unscreened, and the remainder granulated. Sales of screened and air-cooled slag were 52 percent greater in 1941 than in 1940, and the average value per ton was 2 cents lower.

About 73 percent of all slag processed is treated in Ohio, Alabama, and Pennsylvania; however, it is marketed in all States east of the Mississippi River except several New England States too far removed from sources of supply to permit economic utilization.

Air-cooled slag is used principally in the construction and maintenance of highways, as well as in airport runways, parking lots, and building construction and as railway ballast. It is used quite extensively as roofing aggregate and in the manufacture of mineral wool. Granulated slag is used primarily as fill material and as an ingredient of

portland cement. Other uses and the quantities involved are shown in the accompanying table.

Particles of metallic iron that escape through the slag notch of the blast furnace are recovered during the screening process by means of a magnetic separator supplemented by hand picking. During 1941, 137,500 tons of metal were thus recovered and returned to the furnaces to augment supplies urgently needed for the war program.

Exclusive of administrative, office, and sales employees, 1,536 men were employed in processing slag in 1941. A production of 4.8 short tons per man-hour was attained.

Shipments of slag, by methods of transportation, were as follows: Railroad, 55 percent; truck, 43 percent; and waterway, 2 percent.

Air-cooled blast-furnace slag sold or used by producers in the United States, 1940–41, by States [1]

State	1940			1941		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	2,609,273	27 9	$1,718,872	3,698,379	28 1	$2,528,633
Ohio	3,021,039	32.3	2,647,087	4,239,924	32.2	4,000,074
Pennsylvania	1,363,002	14 5	1,295,579	1,667,252	12.6	1,564,823
Other States [2]	2,369,914	25 3	1,861,366	3,564,026	27.1	2,730,739
	9,363,228	100 0	7,522,904	13,169,581	100 0	10,824,269

[1] National Slag Association

[2] Colorado, Illinois, Kentucky, Maryland, Michigan, New York, Tennessee, and West Virginia.

Blast-furnace slag sold or used by producers in the United States in 1941, by uses [1]

Use	Air-cooled						Granulated		
	Unscreened			Screened					
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
Concrete (pavements, buildings, bridges, etc)				2,347,122	$2,120,948	$0.90			
Roads other than concrete	161,093	$81,590	$0.51	6,165,928	5,412,993	.88			
Railroad ballast	545,603	276,173	51	2,511,994	1,632,266	.65	(2)	(2)	(2)
Mineral wool				155,998	145,114	.93			
Roofing				149,268	180,724	1.21			
Fill and subbase cushion courses, etc	90,667	32,319	.36	182,578	128,260	.70	810,195	$59,937	$0.07
Sewage trickle filter				46,775	51,971	1.11			
Airport runways				359,478	341,610	.95			
Parking lots and private driveways				244,958	194,916	57			
Agricultural purposes				33,568	30,252	.90	20,042	17,769	.89
Cement manufacture							(2)	(2)	(2)
Other uses				174,551	195,133	1 12			
Total: 1941	797,363	390,082	49	12,372,218	10,434,187	.84	1,508,685	239,833	.16
1940	1,230,832	507,288	.41	8,132,396	7,015,616	.86	989,814	257,737	.26
1939	812,220	361,554	.45	7,108,061	5,870,582	.83	1,188,094	122,017	.10
1938	1,202,754	567,224	.47	6,118,505	5,600,668	.92	656,807	78,723	.12

[1] National Slag Association.

[2] Concealed to avoid revealing data of individual company; figures included in total

GYPSUM

By Forrest T. Moyer

SUMMARY OUTLINE

The total value of all gypsum products sold or used in 1941 was nearly 70 million dollars, or 30 percent higher than in 1940 and far above that of the previous record year, 1925. Outstanding products were portland-cement retarder, lath, wallboard, sheathing board, and miscellaneous tile shapes, for which striking gains were reported over sales during 1940. Crude supply in 1941 is estimated at 6,000,000 short tons and was attained principally by greatly increased production from domestic mines, which more than offset an indicated small decline in imported crude. Kettle and kiln output of calcined gypsum totaled nearly 4 million tons, or 20 percent more than in 1940 Despite increased costs of labor and materials, prices of gypsum products were relatively unchanged from 1940 in most instances; uncalcined products were slightly higher, industrial plasters unchanged, building plasters slightly lower, and prefabricated products slightly higher in price.

The record annual dollar volume of business for the gypsum industry in 1941 resulted principally from the advanced rate of private building activity, to which was added an extensive program of cantonment and emergency housing for the armed forces and for industrial workers. Private building activity was maintained well above that in 1940 until near the close of 1941, when "housing" priorities established September 22 on some structural materials first noticeably began to curtail the volume of construction not essential to the defense program. After declaration of war on Japan, Germany, and Italy in December, the accelerated military program greatly expanded cantonment and defense housing and thus bolstered a faltering market for gypsum products. The present type of residential construction consists largely of small, low-cost units in which speed and ease of erection and salvageability of materials have prime importance. These factors tend toward wider utilization of prefabricated materials, as is shown by the brisk market for gypsum board in contrast to the much less active demand for plasters.

The outstanding feature of the industry in 1941 was the strikingly increased demand for the three types of gypsum board—lath, wallboard, and sheathing—in each of which sales volumes set new annual

records. The net advance in sales of lath over 1940 was nearly 400 million square feet, which was by far the largest annual increment reported for this product. Indicative of its strong competitive position, sales of lath listed in Bureau of Mines Quarterly Gypsum Reports reached a new record quarterly total in the October-December period of 1941, when a volume of one-half billion square feet was exceeded for the first time. Also evident from this record is the apparent extensive substitution of gypsum lath for metal lath, which was placed under priority regulations after September.

Owing to its widespread use in the construction of barracks, consumption of wallboard in 1941 increased markedly over 1940 to a total of 757½ million square feet and greatly exceeded the quantity sold in any other year.

Although gypsum sheathing was relatively unknown and sales were negligible as recently as 1939, its low cost and adaptability for construction of cantonments and other emergency housing were recognized early in the defense program. Sales jumped from 5¼ million square feet in 1939 to 89½ million in 1940, nearly all of which was sold in the October-December period. In 1941, sales totaled 175 million square feet, another spectacular gain in use that indicates the widespread acceptance of this product as a proved and satisfactory material.

Salient statistics of the gypsum industry in the United States, 1937–41

	1937	1938	1939	1940	1941
Active establishments [1]	92	90	92	91	93
Crude gypsum— [2]					
Mined .... short tons	3,058,166	2,684,205	3,226,737	3,699,015	4,788,534
Imported .... do	897,484	789,429	1,308,078	1,405,210	[3] 868,234
Apparent supply .... do	3,955,650	3,473,634	4,534,815	5,104,225	[4]
Calcined gypsum produced: [5]					
Short tons	2,411,362	2,252,878	2,881,269	3,307,709	3,980,567
Value	$11,076,205	$10,989,626	$14,620,597	$17,254,667	$19,746,914
Gypsum products sold. [5]					
Uncalcined uses:					
Short tons	860,825	756,565	867,782	929,119	1,320,713
Value	$1,920,706	$1,681,371	$1,927,415	$2,250,857	$3,138,958
Industrial uses					
Short tons	125,853	94,248	110,395	123,643	151,960
Value	$1,363,130	$1,154,517	$1,373,564	$1,532,738	$1,885,313
Building uses					
Value	$35,516,684	$33,420,420	$42,627,260	$49,709,049	$64,734,171
Total value	$38,800,520	$36,256,308	$45,928,239	$53,492,644	$69,758,442
Gypsum and gypsum products—					
Imported for consumption	$1,167,872	$1,002,001	$1,363,967	$1,429,289	[3] $844,049
Exported	$271,142	$282,782	$309,453	$264,128	[3] $311,272

[1] Each mine, plant, or combination mine and plant is counted as 1 establishment.
[2] Excludes byproduct gypsum
[3] Figures cover January to September, inclusive
[4] Data not available.
[5] Made from domestic, imported, and byproduct crude gypsum.

Despite greatly increased shipping difficulties due to the war, imports of crude gypsum in the first 9 months of 1941 totaled 868,234 short tons, a decline of only 15 percent from the record tonnage imported during the similar period of 1940. Tidewater calcining plants along the Atlantic coast appeared to have supplies of crude adequate for normal operations in 1941. However, about the middle of the year

some crude reportedly was shipped from the Buffalo region to a calcining plant in the metropolitan New York area via the New York Barge Canal. If imports are halted completely and calcining capacity is needed, crude gypsum for at least partial operation of some tidewater plants probably could be transported from domestic mines by water. It would be more economical, however, to ship calcined gypsum or the finished products into the eastern market area.

Wage increases during 1941 were reported by operators in California, Iowa, Michigan, Nevada, Oklahoma, and Utah, and labor agreements were effected between operators and unions in several producing localities. Labor difficulties lasting through July and August closed nine gypsum operations (eight plants and one mine) in seven States; at the close of 1941 a final agreement had not been reached, although the case had been referred to the National War Labor Board and work had been resumed in all plants.

Jury trial of the criminal charges of fixing prices on gypsum products, brought by the Department of Justice against five producing companies and eight officials, resulted in a directed verdict of acquittal. Still pending are the criminal actions against three companies for alleged illegal price control of perforated lath and a civil action on seven companies and seven officials for conspiring to restrain trade and control prices in violation of the Sherman Antitrust Act.

The wide and rather regular distribution of domestic mines and plants processing gypsum is shown on the map (fig. 1) of gypsum operations. The New England, Southeastern, and Pacific Northwest States lack domestic sources of crude supplies, but only the Pacific Northwest is without a gypsum-processing plant.

DOMESTIC PRODUCTION

Domestic mines produced 29 percent more crude gypsum in 1941 than in 1940; the output was obtained in 16 States from 60 operations, comprising 28 underground mines, 26 open quarries, and 6 mine-quarry

Crude gypsum mined in the United States, 1939–41, by States

State	1939			1940			1941		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
California	5	188,364	$306,350	6	259,321	$437,504	7	381,951	$618,685
Colorado	3	24,013	40,694	3	24,641	36,787	(1)	(1)	(1)
Iowa	9	430,712	510,120	8	487,379	587,223	8	630,930	786,185
Michigan	5	643,180	834,856	5	746,982	1,017,126	5	805,861	1,090,309
Nevada	4	205,762	484,621	4	250,632	618,050	4	284,795	754,294
New York	9	709,495	971,229	9	798,229	1,037,181	9	1,080,320	1,500,807
Oklahoma	3	161,748	207,503	3	176,166	227,534	3	258,258	344,489
Texas	6	283,912	266,265	7	328,261	368,882	7	446,419	467,087
Utah	4	58,146	65,269	4	45,421	60,055	4	61,813	78,147
Other States [2]	12	521,405	744,098	10	581,983	837,568	13	838,187	1,204,720
	60	3,226,737	4,431,005	59	3,699,015	5,227,910	60	4,788,534	6,794,223

[1] Included under "Other States."

[2] By groups of States as follows—1939: Arizona (1 active mine), Kansas (2), Montana (2), South Dakota (1), and Wyoming (2)—188,540 short tons valued at $219,796; Ohio (2) and Virginia (2)—332,865 tons, $524,302. 1940: Kansas (2), Montana (2), South Dakota (1), and Wyoming (1)—197,703 tons, $227,025; Ohio (2) and Virginia (2)—384,280 tons, $610,543. 1941: Arkansas (1) and Kansas (2)—174,918 tons, $177,499; Colorado (2), Montana (2), South Dakota (1), and Wyoming (1)—149,848 tons, $222,710; Ohio (2) and Virginia (2)—513,421 tons, $804,511.

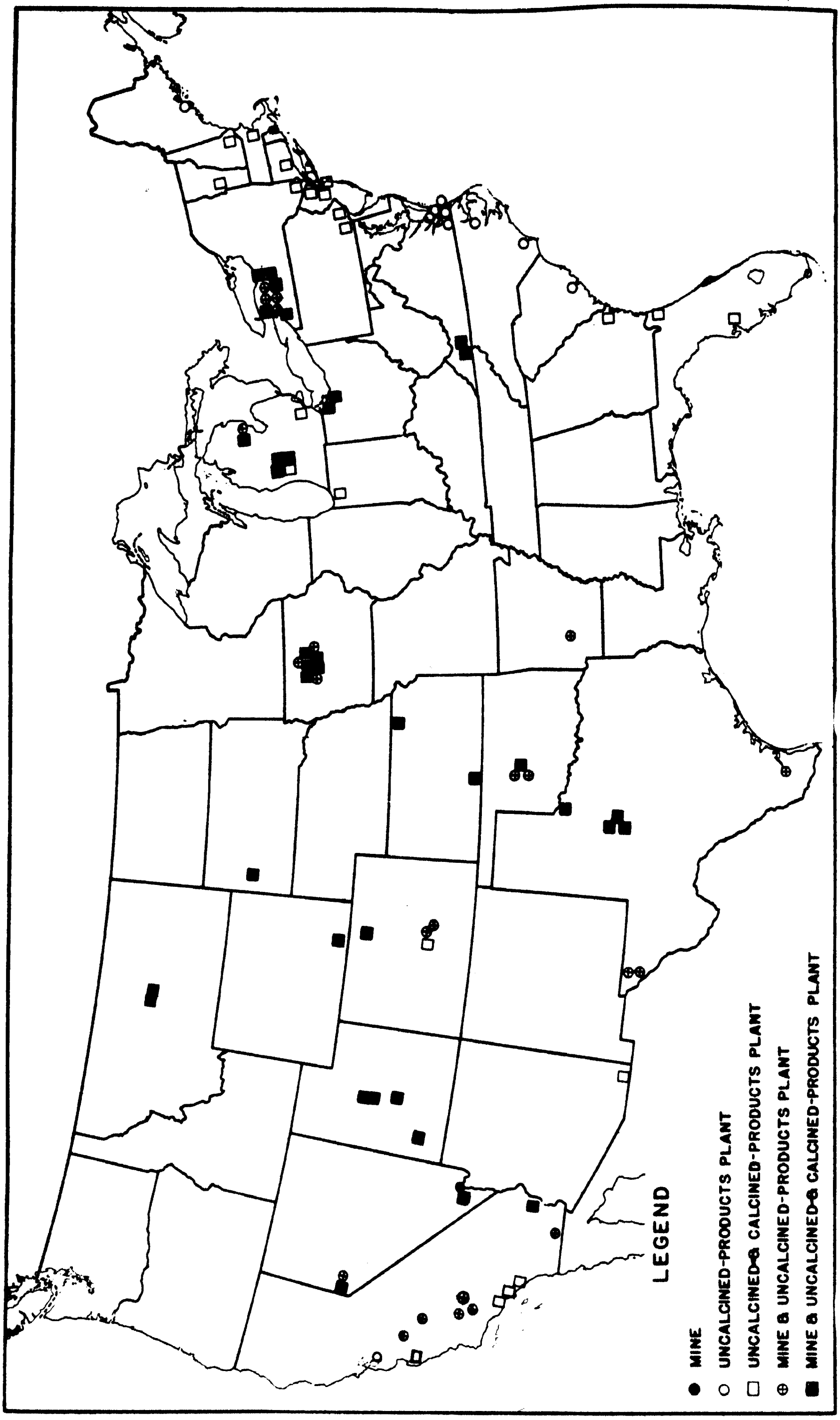

FIGURE 1.—Geographic distribution of gypsum mines and processing plants in the United States.

combinations. Output increased in nearly all the States, with New York, Michigan, Iowa, and Texas (in order of tonnage) continuing as the leading producers.

Average estimated value of run-of-mine gypsum advanced 1 cent to $1.42 per ton in 1941. As reported by the producers, this is essentially a "transfer" value, because run-of-mine material seldom is bought and sold in open market. Data in the preceding table do not include byproduct crude gypsum.

CAPACITIES AND EQUIPMENT OF PROCESSING PLANTS

Calcined gypsum was produced in 25 States by 57 plants—45 processing domestic crude, 11 imported crude, and 1 byproduct crude gypsum. Total kettle and kiln output was 3,980,567 short tons—a net gain of 672,858 tons over 1940. Active calcining equipment included 179 kettles, 13 rotary kilns, 8 beehive kilns, and 4 grinding-calcining kiln-mills. Equipment that was idle throughout 1941 included 10 kettles, 1 rotary kiln, and 1 beehive kiln.

Capacities and number of calcining units [1] in active gypsum calcining plants in the United States in 1941, by types and status of equipment and by districts

District	Active calcining plants	Kettles				Rotary kilns				Total capacity per 24-hour day		
		Active		Inactive		Active		Inactive				
		Number	Capacity per 24-hour day (short tons)	Number	Capacity per 24-hour day (short tons)	Number	Capacity per 24-hour day (short tons)	Number	Capacity per 24-hour day (short tons)	Active (short tons)	Inactive (short tons)	Total (short tons)
New Hampshire, Vermont, Massachusetts, and Connecticut	4	[2] 7	[2] 1,399	1	64	(3)	(3)	1	50	1,399	114	1,513
Eastern New York, New Jersey, and Pennsylvania	5	[2] 23	[2] 4,722			(3)	(3)			4,722		4,722
Virginia, Georgia, and Florida	5	[2] 15	[2] 2,124			(3)	(3)			2,124		2,124
Western New York	5	[2] [4] 21	[2] [4] 4,491	(3)	(3)	(3)	(3)			[4] 4,491	(5)	4,491
Ohio, Michigan, and Indiana	8	[2] [4] 34	[2] [4] 6,144	(3)	(3)	(3)	(3)			[4] 6,144	(5)	6,144
Iowa	5	[4] 19	[4] 2,728	(3)	(3)					[4] 2,728	(5)	2,728
Kansas and Oklahoma	3	[2] 11	[2] 1,305			(3)	(3)			1,305		1,305
Texas	4	25	2,448	4	259					2,448	259	2,707
Colorado, Wyoming, South Dakota, and Montana	6	11	1,003							1,003		1,003
Utah	4	8	495							495		495
Nevada and Arizona	3	10	1,015							1,015		1,015
California	5	13	1,480			[6] 4	[6] 288			1,768		1,768
Summary	57	179	22,395	10	828	[7] 17	[7] 6,742	1	50	29,137	878	30,015

[1] Capacities expressed as output of "first-settle" calcined gypsum suitable for use in common wall or base-coat plasters. Figures do not include data on beehive kilns, see text.
[2] Includes data on active rotary kilns in this district.
[3] Included with data on active kettles in this district.
[4] Includes data on inactive kettles in this district.
[5] Included with active capacity of this district.
[6] Figures refer to grinding-calcining kiln-mills.
[7] Includes data on active grinding-calcining kiln-mills.

The capacities of calcining equipment in plants that were active during all or part of 1941 totaled 30,015 short tons per 24 hours of "first-settle" calcined gypsum suitable for use in common wall or base-coat plasters. The data in the preceding table include the capacity of a new calcining plant in Nevada that did not begin operations until early in 1942 but do not include the capacities of two inactive calcining plants, one in California and the other in Washington. The capacities of beehive kilns are not included, as equipment of this type is adapted only to the manufacture of Keene's cement.

Processors' reports on the average number of operating days a year for each kettle after allowances for repair shut-downs, etc., ranged from 45 to 340 days. However, the largest grouping of kettles was in the range from 251 to 300 days, in which reports on 76 kettles had an arithmetical average of 294 days a year. For rotary kilns, reports on the number of working days a year ranged from 135 to 330 and averaged 252 days. By calculations employing the figures on operating days, active daily capacity of kettles and rotary kilns, and calcined gypsum production it is shown that only 48 percent of the calcining capacity of the country was utilized in 1941.

Plants along the Atlantic seaboard that depend on imported supplies of crude have an aggregate active calcining capacity of 6,917 short tons and a total capacity of 7,031 tons per 24 hours.

Because gypsum board of different type and thickness is made at different speeds on account of drying problems, the total capacities of the manufacturing machines are shown in the accompanying table for each of three standard types and two thicknesses of board. The capacities of a new machine that began operations early in 1942 are included in the data. The aggregate capacity of the 36 active board machines is 13,104,600 square feet of ⅜-inch lath in 24 hours, but when making sheathing their capacity falls to 7,438,280 square feet. Reports on the number of operating days in the year per machine ranged from 217 to 350 and averaged 304 days.

Number and capacities [1] of active gypsum-board machines in the United States in 1941, by standard types of board and by districts

District	Number of machines	Capacity per 24-hour day, in square feet of—				Operating days per machine in year [2]	
		⅜-inch lath	⅜-inch wallboard	½-inch wallboard	½-inch sheathing board	Range [3]	Average [4]
New Hampshire, Massachusetts, eastern New York, New Jersey, and Pennsylvania	6	2,562,000	2,059,000	1,610,000	1,321,000	300–330	311
Western New York	6	2,130,400	1,945,200	1,423,000	1,340,800	300–353	320
Ohio, Michigan, and Indiana	7	2,576,400	2,126,600	1,597,200	1,336,680	231–350	299
Iowa	3	1,280,800	993,800	777,600	696,800	240–320	287
Virginia, Georgia, Florida, Oklahoma, and Texas	8	2,795,000	2,434,000	1,889,000	1,793,000	217–343	297
California, Nevada, and Montana	6	1,760,000	1,440,000	1,070,000	950,000	250–350	308
Total	36	13,104,600	10,998,600	8,366,800	7,438,280	217–350	304

[1] Expressed as square feet per 24 hours upon basis of manufacturing only standard board of specified type during the 24 hours.
[2] Estimated by processor at capacity rate of operation, after allowances for repair shut-downs, etc.
[3] In reports on individual machines
[4] Sum of operating days for each machine divided by number of machines.

From the data in the table, multiplication factors to convert square footages of one board type into an equivalent area of ⅜-inch lath are as follows: For ⅜-inch wallboard, 1.191; for ½-inch wallboard, 1.566; and for ½-inch sheathing, 1.762. Using the foregoing data and assuming that half of the wallboard sales were of ⅜-inch thickness and the remainder of ½-inch thickness, it is calculated that the rate of board manufacture was 81 percent of the total available capacity at the end of 1941. The actual rate of operations was higher, however, as the calculations do not allow for spoilage and breakage and all of the machines were not available throughout the year.

DISTRIBUTION OF SALES BY USES

The pronounced gain in sales of portland-cement retarder over 1940 correlates closely with the increased rate of operations in the portland-

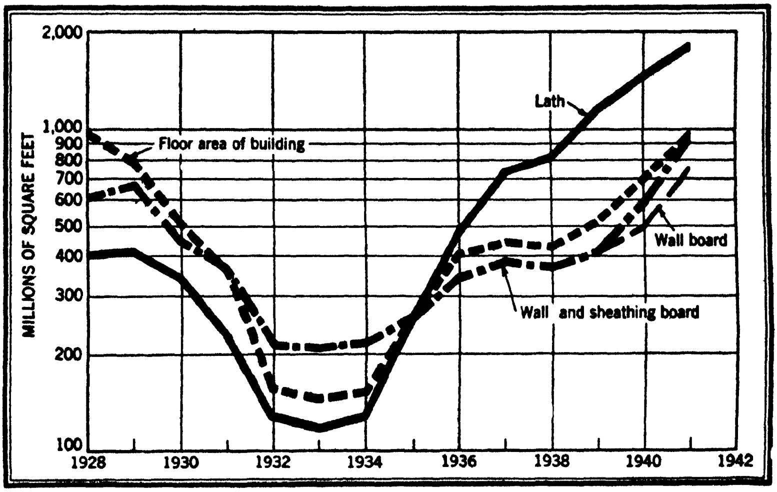

FIGURE 2.—Sales of gypsum lath and wall and sheathing boards compared with F. W. Dodge Corporation figures on floor area of residential and nonresidential building, 1928–41.

cement industry. Although consumption of agricultural gypsum in the Virginia and Carolina peanut area declined to approximately 50,000 short tons in 1941, total consumption in the country, after adjustment for comparability, was about 10 percent higher than in 1940, principally because its use was increased in California on all types of soil for fertilizing potatoes, cotton, alfalfa, and grapevines.

All classes of industrial plasters showed marked sales increases during 1941, and the total tonnage for this group was 23 percent above 1940. The use of gypsum plaster to make molds for metal castings is said to be increasing steadily under the stimulus of the war program.

Sales volumes of all the principal classes of building plasters were higher than in 1940, except for the group of miscellaneous plasters (patching, painter's, etc.) in which sales dropped 13 percent.

Notable features shown in figure 2 are the marked expansion in use of gypsum lath since 1933 and the effects of the defense and war programs upon consumption of the three types of gypsum board since 1940. Sales of sheathing before 1939 are said to be negligible and

are included with those of wallboard The semilog or ratio scale used in figure 2 shows fluctuations in the annual physical volume of sales and floor area of building and also permits ready comparison of the rates of increase or decrease.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1940–41, by uses

Use	1940			1941				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
Uncalcined:								
Portland-cement retarder	820,828	$1,599,511	$1.95	1,153,443	$2,304,910	$2.00	+41	+3
Agricultural gypsum	92,232	502,298	5.45	149,196	667,342	4.47	(1)	(1)
Other uses [2]	16,059	149,048	9.28	18,074	166,706	9.22	+13	−1
Total uncalcined uses	929,119	2,250,857	------	1,320,713	3,138,958	------	+42	------
Industrial:								
Plate-glass and terra-cotta plasters	40,741	276,891	6.80	48,214	331,860	6.88	+18	+1
Pottery plasters	20,138	264,975	13.16	26,022	338,708	13.02	+29	−1
Orthopedic and dental plasters	9,787	324,567	33.16	11,568	394,661	34.12	+18	+3
Other industrial uses [3]	52,977	666,305	12.58	66,156	820,084	12.40	+25	−1
Total industrial uses	123,643	1,532,738	------	151,900	1,885,313	------	+23	------
Building:								
Cementitious:								
Plasters:								
Base-coat	1,475,033	13,012,665	8.82	1,532,829	13,505,974	8.81	+4	------
Sanded	132,306	732,503	5.54	132,628	774,465	5.84	----	+5
To mixing plants	17,456	107,671	6.17	20,878	126,391	6.05	+20	−2
Gauging and molding	163,650	2,036,150	12.44	171,954	2,125,926	12.36	+5	−1
Prepared finishes	12,455	344,908	27.69	12,882	334,040	25.93	+3	−6
Insulating and roof-deck	18,561	162,100	8.73	24,079	200,912	8.34	+30	−4
Other [4]	16,104	513,621	31.89	14,031	520,755	37.11	−13	+16
Keene's cement	26,962	419,177	15.55	29,816	464,219	15.57	+11	------
Total cementitious	1,862,527	17,328,795	------	1,939,097	18,052,682	------	+4	------
Prefabricated:								
Lath [5]	1,072,555	18,189,358	[6] 12.54	1,357,641	23,524,812	[6] 12.76	[7] +27	[6] +2
Wallboard [8]	380,125	10,595,245	[6] 21.57	612,203	16,578,698	[6] 21.88	[7] +54	[6] +1
Sheathing board [9]	86,945	1,632,688	[6] 18.22	179,275	3,287,699	[6] 18.73	[7] +96	[6] +3
Tile [10]	178,315	1,962,963	[11] 45.58	198,578	3,290,280	[11] 39.53	[7] +16	[11] −13
Total prefabricated	1,717,940	32,380,254	------	2,347,697	46,681,489	------	+37	------
Total building uses	------	49,709,049	------	------	64,734,171	------	----	------
Grand total value	------	53,492,644	------	------	69,758,442	------	----	------

[1] Not comparable; see text.
[2] Includes uncalcined gypsum sold for use as filler and rock dust, in paint manufacturing, and for minor purposes.
[3] Includes statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous sales.
[4] Includes joint filler, patching and painter's plaster, and unclassified building plasters.
[5] 1940: 1,450,069 M square feet; 1941: 1,843,048 M square feet.
[6] Average value per M square feet.
[7] Percent of change in square footage.
[8] 1940: 491,291 M square feet; 1941: 757,588 M square feet.
[9] 1940: 89,631 M square feet; 1941: 175,496 M square feet.
[10] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks—1940: 30,026 M square feet, 1941: 34,877 M square feet.
[11] Average value per M square feet of partition tile only.

Although over-all consumption of gypsum tiles increased markedly in 1941, the gain was due entirely to greatly increased sales of miscellaneous tiles (roof, floor, shoe, etc.) and plank in which square footages sold were more than two and a half times those in 1940. In contrast, sales of partition tiles fell approximately one-fifth below the square footages sold in 1940.

PRICES

Prices of gypsum products, as indicated by the average unit values, f. o. b. plant, showed no general trend in 1941 but remained at essentially the same levels as in 1940. The only significant change was the 13-percent decline noted for the average value of partition tiles. In 1941, the unit value of agricultural gypsum comparable with the 1940 value was $6.01 a ton, a 10-percent gain caused largely by price increases in the Southeastern States necessary to cover the higher transportation costs in obtaining crude supplies from Canada.

RECENT DEVELOPMENTS

Research and technical work in the gypsum industry in 1941 was directed toward the enlarging of capacity to produce gypsum board and the development of products to fit industrial, farming, and other nonbuilding uses. Further refinements were made in the high-strength gypsum cement used for oil-well drilling and in a new molding plaster used in place of sand molds in metal casting work. One company established experimental farms to promote uses of its products.

Satisfactory alkali resistance in exterior concrete and brick paints of the conventional oil types is said to be obtained [1] when 15 to 20 percent of the pigment is gypsum, either as plaster of paris or as terra alba.

Research [2] on calcium sulfate showed the high-temperature form to be unstable and did not confirm the existence of basic sulfates of calcium.

Gypsum or anhydrite in place of salt cake in the kraft-paper industry [3] continues to be a practical substitution in mills where gypsum supplies can be delivered for less than $5 and salt cake for more than $17.40 a ton.

FOREIGN TRADE [4]

Imports and exports of crude gypsum and gypsum products in 1941 are available for publication for the first 9 months only; later data are to be confidential for the war period.

Imports.—Crude gypsum brought to processing plants on tidewater along the Atlantic coast comprises practically all of the import trade in gypsum. During the first 9 months of 1941 crude imports

[1] Fuller, Wayne R., Inert Materials for Admixture with Paint Pigments: Am. Soc. Test. Materials Bull 105, August 1940, p. 37.

[2] Newman, Edwin S., Behavior of Calcium Sulfate at High Temperatures: Nat. Bureau of Standards, Jour. Research, vol 27, No 2, August 1941, pp. 191-196.

[3] Chemical and Metallurgical Engineering, Gypsum in Place of Salt Cake: Vol. 48, No. 2, February 1941, p. 163.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

were 15 percent below the record tonnage that entered the country during the same period of 1940. It is noteworthy, however, that the 9-month volume in 1941 was approximately the same as the 12-month totals in 1937 and 1938. Importations of gypsum products and manufactures virtually ceased in 1941, and 9-month values reported for these classifications aggregated only $42,753, which represents a monthly rate 56 percent lower than in 1940.

Gypsum and gypsum products imported for consumption in the United States, 1937–41

Year	Crude (including anhydrite)		Ground		Calcined		Keene's cement		Alabaster manufactures [1]	Other manufactures, n. e. s.	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
1937	897,484	$854,835	1,711	$22,165	353	$7,917	25	$675	$203,824	$78,456	$1,167,872
1938	789,429	772,026	1,486	17,674	372	7,649	9	223	159,551	44,878	1,002,001
1939	1,308,078	1,174,117	1,475	17,606	302	6,551	4	145	110,136	55,412	1,363,967
1940	1,405,210	1,300,450	1,137	16,206	223	5,087	9	265	71,143	36,138	1,429,289
1941 [2]	868,234	801,296	1,300	23,174	74	2,257	16	427	2,991	13,904	844,049

[1] Includes imports of jet manufactures, which are reported to be negligible.
[2] January to September, inclusive.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1939–41, by countries

Country	1939		1940		1941 (Jan.-Sept.)	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	1,243,390	$1,112,967	1,368,194	$1,260,076	865,965	$797,213
China	(1)	18			1	15
Hong Kong					(1)	5
Italy	116	2,942	184	4,495		
Mexico	58,955	53,341	32,134	29,056		
United Kingdom	5,617	4,849	4,698	6,823	2,268	4,063
	1,308,078	1,174,117	1,405,210	1,300,450	868,234	801,296

[1] Less than 1 ton.

Tidewater quarries in New Brunswick and Nova Scotia, Canada, supplied nearly all the crude imported during the first 9 months of 1941. Imports into southern California from San Marcos Island, Baja California, Mexico, ceased in 1940, marking the first break in this raw-material flow that began in 1925 and usually comprised 5 to 10 percent of the total annual crude imports.

Gypsum and gypsum products exported from the United States, 1937–41

Year	Crude, crushed, or ground		Plasterboard and wallboard		Calcined		Other manufactures, n. e. s.	Total value
	Short tons	Value	Square feet	Value	Short tons	Value		
1937	4,777	$26,692	4,360,404	$96,019	2,847	$61,383	$87,048	$271,142
1938	2,844	17,762	3,658,647	88,822	3,833	71,914	104,284	282,782
1939	10,342	41,012	5,258,249	130,073	2,913	69,577	68,791	309,453
1940	5,209	31,564	4,152,452	101,680	2,208	56,419	74,465	264,128
1941 (Jan.-Sept.)	9,019	43,179	7,604,879	159,917	1,986	54,768	53,408	311,272

Export activity increased markedly during 1941, and the monthly rate of total value of materials exported during the first 9 months was 57 percent greater than that in the year 1940; however, exports comprise only a small part of the domestic industry.

WORLD PRODUCTION

The United States doubtless continued to be the leading producer of crude gypsum, although data on production in other countries are fragmentary. Output from Canadian operations was 10 percent higher than in 1940 and set a new record annual tonnage for that country. In other countries that formerly had large production, mining activities undoubtedly were curtailed drastically because of the war.

World production of gypsum, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Algeria	46,175	33,325	[2]	[2]	[2]
Anglo-Egyptian Sudan				[2]	[2]
Argentina [3]	68,220	70,813	87,328	103,157	[2]
Australia:					
New South Wales	9,300	12,712	[2]	[2]	[2]
South Australia	117,985	148,943	147,266	155,901	[2]
Victoria	21,197	13,596	11,966	[2]	[2]
Western Australia	9,219	13,645	14,570	13,020	[2]
Belgian Congo	[2]	1,000	[2]	500	[2]
Brazil [4]	2,000	2,000	2,000	2,000	[2]
Canada	1,044,222	915,169	1,289,950	1,314,311	1,442,707
Chile	24,980	24,551	22,209	25,865	[2]
China	[2]	[2]	[2]	75,000	[2]
Cuba	15,028	7,257	6,270	12,000	[2]
Cyprus	[5] 13,576	[5] 9,729	[5] 5,058	[4] 1,400	[2]
Egypt	253,641	212,088	700,166	61,847	[2]
Eire	11,647	13,364	16,168	21,662	24,660
Estonia	12,748	13,915	[2]	[2]	[2]
France	1,320,400	[2]	[2]	[2]	[2]
Germany	[2]	[2]	[2]	[2]	[2]
Austria [6]	47,000	[2]	[2]	[2]	[2]
Greece	17,924	16,609	15,219	[2]	[2]
India, British	46,830	70,944	69,786	[2]	[2]
Iraq			69,545	34,879	[2]
Italy	416,198	425,299	[2]	[2]	[2]
Latvia	[5] 196,911	220,000	245,035	[2]	[2]
Luxemburg	19,722	19,901	[2]	[2]	[2]
New Caledonia	984	1,070	[2]	3,000	[2]
Palestine	3,934	3,984	4,524	4,403	[2]
Peru	12,895	14,026	15,655	21,478	25,000
Portugal	11,390	9,036	[2]	[2]	[2]
Rumania	70,620	69,079	[2]	[2]	[2]
Sweden	108	95	102	[2]	[2]
Switzerland	35,000	35,000	38,000	30,000	[2]
Tunisia	22,800	[2]	[2]	[2]	[2]
Union of South Africa	33,186	38,849	40,782	[2]	[2]
United Kingdom	1,111,669	1,109,928	[2]	[2]	[2]
United States	2,774,307	2,435,057	2,927,231	3,355,672	4,344,062

[1] In addition to the countries listed, gypsum is produced in Chosen, Japan, French Morocco, Mexico, Poland, Spain, U. S. S. R., and Yugoslavia, but production data are not available.
[2] Data not available.
[3] Rail and river shipments.
[4] Approximate production.
[5] Exports of crude and calcined gypsum.
[6] Estimate furnished by Bundesministerium für Handel und Verkehr.

LIME

By Oliver Bowles and F. D. Gradijan

SUMMARY OUTLINE

SUMMARY

Production of lime attained an all-time high of 6,079,416 short tons in 1941 and exceeded the previous record of 1940 by 24 percent. This marked increase in output was accompanied by an increase of 11 cents a ton in average value for all lime at the point of production.

Sales of agricultural lime increased 5 percent in 1941 compared with 1940, and the average value per ton rose from $5.71 to $6.24. The increase is due in part to activities of Agricultural Adjustment Administration county agents in promoting wider use of liming materials.

Building lime increased 5 percent in volume of sales over 1940, whereas the unit value advanced 3 percent.

Sales of lime for chemical and industrial purposes increased 35 percent over 1940, reflecting the tremendously increased activity in the heavy industries fostered by the war program. The price of chemical and industrial lime held steady, showing an increase of only 0.5 percent over 1940. Sales of refractory lime gained 23 percent in quantity over 1940, accompanied by a sharp upturn in unit value.

Among the major chemical and industrial uses, the most notable gains were in metallurgical lime (37 percent) and in lime used by tanneries (29 percent). For the third consecutive year, the quantity of metallurgical lime consumed in 1941 represented a new all-time high. As in 1940, sales of metallurgical lime increased far more than the increase in steel-ingot output would indicate. It is suggested that this discrepancy may be due in part to the increased use of brown iron ores, which—because of their higher phosphorus content—require larger quantities of flux than the average low-phosphorus ores.

Data on prices show that the steady decline in averages since 1937 has been arrested by an upward trend in all major categories in 1941.

Salient statistics of the lime industry in the United States, 1940–41

	1940			1941				
	Short tons	Value		Short tons	Value		Percent of increase in—	
		Total	Average		Total	Average	Tonnage	Average value
Lime sold or used by producers:								
By classes:								
Quicklime	3,501,104	$23,433,807	$6.69	4,489,257	$30,586,364	$6.81	28.2	1.8
Hydrated lime	1,385,825	10,522,578	7.59	1,590,159	12,354,798	7.77	14.7	2.4
Total lime	4,886,929	33,956,385	6.95	6,079,416	42,941,162	7.06	24.4	1.6
By uses:								
Agricultural	364,823	2,084,462	5.71	382,727	2,387,045	6.24	4.9	9.3
Building	1,010,435	8,542,207	8.45	1,065,599	9,259,118	8.69	5.5	2.8
Chemical and industrial	2,643,762	16,404,388	6.20	3,561,203	22,183,827	6.23	34.7	.5
Refractory (dead-burned dolomite)	867,909	6,925,328	7.98	1,069,887	9,111,172	8.52	23.3	6.8
Imports for consumption:								
Quicklime and hydrated lime	9,205	81,888	8.90	[1] 9,165	[1] 78,860	8.60		
Exports	31,912	311,619	9.76	[1] 32,444	[1] 318,541	9.82		

[1] Figures cover January to September, inclusive.

PRODUCTION

As quicklime is a semiperishable product, stocks are never large. Quantities sold or used may therefore be considered equivalent to production.

Production of quicklime was 28 percent greater in 1941 than in 1940, and hydrated-lime production increased 15 percent. Average values were considerably higher. Data on unit values, by individual uses, are indicated in a later section of this chapter. The following table shows production during recent years.

Lime sold or used by producers in the United States, 1937–41

Year	Plants in operation	Short tons [1]	Value [2]	
			Total [1]	Average
1937	314	4,124,165	$30,091,168	$7.30
1938	321	3,346,954	24,137,638	7.21
1939	311	4,254,348	30,049,394	7.06
1940	314	4,886,929	33,956,385	6.95
1941	309	6,079,416	42,941,162	7.06

[1] Includes lime used by producers (captive tonnage) as follows—1937: 270,192 tons valued at $1,388,052; 1938: 168,245 tons, $985,003; 1939: 270,087 tons, $1,454,285; 1940. 339,441 tons, $1,804,017; 1941. 499,062 tons, $2,556,240

[2] Value given represents value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

PRODUCTION BY STATES

Lime was produced in 38 States and 2 Territories during 1941. The leading producers were Ohio, Pennsylvania, Missouri, and West Virginia, which together supplied 60 percent of the total. Ohio alone

contributed 25 percent. The number of plants, production, and value of sales in each State are shown in the following table, insofar as the data can be presented without revealing figures of individual companies.

Lime sold or used by producers in the United States, 1940–41, by States

State	1940			1941		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	8	234,147	$1,359,371	9	306,836	$1,705,558
Arizona	4	67,882	502,998	3	58,146	413,095
Arkansas	2	(1)	(1)	2	(1)	(1)
California	12	112,522	1,031,352	9	122,375	1,168,767
Colorado	5	7,944	82,486	3	(1)	(1)
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	4	25,038	227,440	4	23,265	216,254
Georgia	1	13,774	92,281	1	12,515	85,325
Hawaii	1	(1)	(1)	1	8,681	137,195
Idaho	2	(1)	(1)	1	120	2,160
Illinois	7	161,358	1,150,113	9	246,574	1,702,129
Indiana	4	84,462	457,629	3	106,407	588,879
Kentucky	1	(1)	(1)	--------	--------	--------
Louisiana	--------	--------	--------	2	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	15	63,745	355,771	13	65,624	431,200
Massachusetts	6	108,797	965,333	6	106,336	1,007,773
Michigan	4	41,814	308,926	4	55,447	388,104
Minnesota	2	(1)	(1)	2	(1)	(1)
Missouri	10	607,062	3,184,293	11	736,200	4,106,468
Montana	4	18,797	77,658	2	(1)	(1)
Nevada	2	(1)	(1)	3	(1)	(1)
New Jersey	4	28,854	206,326	4	(1)	(1)
New Mexico	2	(1)	(1)	2	(1)	(1)
New York	5	54,364	408,645	5	62,339	463,230
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	23	1,284,877	10,180,785	22	1,549,246	12,482,106
Oklahoma	2	(1)	(1)	3	(1)	(1)
Oregon	1	(1)	(1)	1	3,940	21,524
Pennsylvania	90	833,038	5,622,725	89	1,003,039	7,263,779
Puerto Rico	4	3,719	33,120	6	8,159	114,728
Rhode Island	1	(1)	(1)	1	(1)	(1)
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	10	192,133	1,050,199	10	239,528	1,354,642
Texas	9	64,274	543,130	9	77,783	632,099
Utah	8	49,413	306,357	9	56,221	352,306
Vermont	5	61,026	430,178	5	67,824	479,219
Virginia	23	178,036	1,044,229	25	224,293	1,359,281
Washington	6	53,428	582,416	4	62,309	656,363
West Virginia	10	278,300	1,727,844	10	372,677	2,350,362
Wisconsin	11	65,632	542,749	10	79,077	659,324
Undistributed [2]	--------	192,493	1,482,031	--------	424,455	2,799,292
	314	4,886,929	33,956,385	309	6,079,416	42,941,162

[1] Included under "Undistributed."
[2] Includes items entered as "(1)."

LOCATION OF PLANTS

The accompanying map (fig. 1) shows the location of active lime plants in the United States that reported to the Bureau of Mines for 1940. The largest demands for building lime, as well as for that used in the chemical and processing industries, are in populous industrial centers. This explains the intensive development of lime plants in Pennsylvania, Maryland, and Ohio. The metropolitan areas of Boston, New York, and Washington, D. C., are notably lacking in lime plants because limestone deposits are not available in these territories. The following nine States had no lime plants reporting activity in 1940: New Hampshire, Delaware, South Carolina, Mississippi,

Iowa, Kansas, Nebraska, North Dakota, and Wyoming. In some of these States, no satisfactory limestone deposits are available; in others, the market demands can be supplied more economically from sources outside the State than from development of local deposits. Limestones are widely distributed, and new plants could be estab-

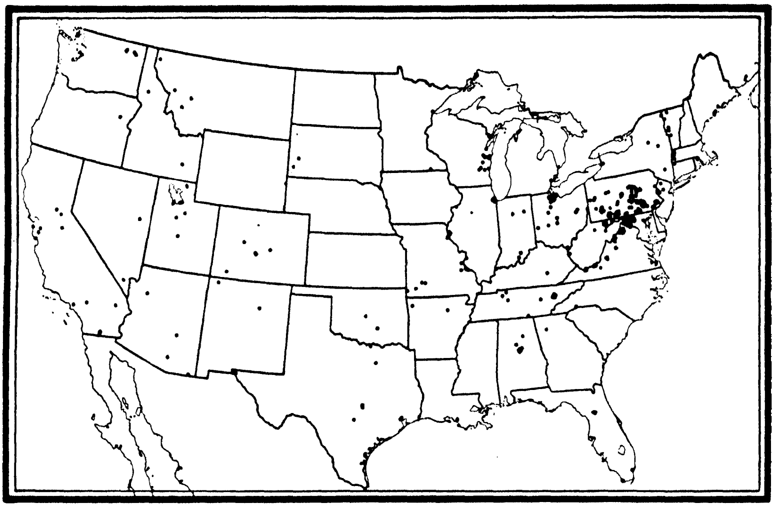

FIGURE 1.—Location of lime plants in the United States.

lished in many localities where they do not now exist, provided markets were large enough to justify operation.

PRODUCTION BY USES

Thirty years ago chemical and industrial plants consumed much less than half as much lime as the building trades. In 1941 the tonnage of lime applied to chemical and industrial uses was more than three times that used for building lime. On the other hand the quantity of lime used in agriculture has fluctuated only moderately, depending primarily on the buying power of the farmer. The most striking gain in any one use during 1941 was in metallurgical lime, which, under the stimulus of a steel industry operating at virtually 100 percent of capacity, increased 37 percent over 1940. The following table shows sales of lime, by principal uses.

Lime sold or used by producers in the United States, 1940–41, by uses

Use	1940				1941			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Agricultural	7.5	364,823	$2,084,462	$5.71	6.3	382,727	$2,387,045	$6.24
Building	20.7	1,010,435	8,542,207	8.45	17.5	1,065,599	9,259,118	8.69
Chemical and industrial:								
Glassworks	3.4	168,044	1,139,381	6.78	3.0	184,559	1,253,700	6.79
Metallurgy	20.4	999,215	5,792,745	5.80	22.5	1,366,899	8,070,180	5.90
Paper mills	11.6	566,818	3,457,354	6.10	11.1	677,116	4,234,772	6.25
Sugar refineries	.4	19,089	197,251	10.33	.4	23,169	248,602	10.73
Tanneries	1.5	72,417	495,864	6.85	1.5	93,157	649,002	6.97
Water purification	5.4	266,088	1,715,849	6.45	5.3	319,244	2,072,807	6.49
Other uses [1]	11.3	552,091	3,605,944	6.53	14.8	897,059	5,654,764	6.30
	54.0	2,643,762	16,404,388	6.20	58.6	3,561,203	22,183,827	6.23
Refractory lime (dead-burned dolomite)	17.8	867,909	6,925,328	7.98	17.6	1,069,887	9,111,172	8.52
Total lime	100.0	[2]4,886,929	[2]33,956,385	6.95	100.0	[2]6,079,416	[2]42,941,162	7.06
Hydrated lime (included in above totals)	28.4	1,385,825	10,522,578	7.59	26.2	1,590,159	12,354,798	7.77

[1] Details of distribution shown in a following table.
[2] Includes lime used by producers (captive tonnage), as follows—1940. 339,441 tons valued at $1,804,017; 1941. 499,062 tons, $2,556,240.

The following table shows production in each State in 1941 according to principal uses, insofar as the figures may be revealed.

Lime sold or used by producers in the United States in 1941, by States and uses

State	Agricultural		Building		Chemical and industrial												Total	
					Metallurgical		Paper mills		Refractory		Tanneries		Water purification		Other			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	48,938	$310,713	154,736	$797,854	72,837	$409,571	(1)	(1)	(1)	(1)	(1)	(1)	10,032	$65,581	306,836	$1,705,558
Arizona	(1)	(1)	(1)	(1)	45,724	286,793	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)	58,146	413,095
Arkansas	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
California	636	$4,958	27,776	311,259	32,325	313,814	(1)	(1)	-----	-----	(1)	(1)	5,994	$50,054	52,887	461,591	122,375	1,168,767
Colorado	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Florida	(1)	(1)	6,021	56,550	-----	-----	134	938	-----	-----	-----	-----	7,255	67,564	(1)	(1)	23,265	216,254
Georgia	2,767	14,570	9,748	70,755	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	12,515	85,325
Hawaii	-----	-----	1,174	18,960	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7,507	118,235	8,681	137,195
Idaho	-----	-----	120	2,160	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	120	2,160
Illinois	331	2,670	22,628	181,192	93,646	562,116	13,896	85,884	(1)	(1)	(1)	(1)	31,041	208,433	(1)	(1)	246,574	1,702,129
Indiana	(1)	(1)	6,129	41,494	(1)	(1)	19,611	107,028	-----	-----	(1)	(1)	(1)	(1)	32,605	173,585	106,407	588,879
Louisiana	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Maine	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland	49,516	311,961	(1)	(1)	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)	65,624	431,200
Massachusetts	7,865	56,424	58,136	611,545	(1)	(1)	10,566	84,874	-----	-----	11,995	$107,920	(1)	(1)	14,511	121,249	106,336	1,007,773
Michigan	2,948	5,226	3,029	26,544	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	4,228	25,700	7,003	61,642	55,447	388,104
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	-----	-----	55,559	380,129	148,446	735,689	89,800	440,475	(1)	(1)	(1)	(1)	102,265	563,629	(1)	(1)	736,200	4,106,468
Montana	-----	-----	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Nevada	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
New Mexico	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
New York	1,109	7,266	6,727	40,884	(1)	(1)	(1)	(1)	-----	-----	283	3,476	(1)	(1)	(1)	(1)	62,339	463,230
North Carolina	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
Ohio	23,139	155,735	475,071	4,221,951	116,009	676,457	37,306	222,726	652,094	$5,563,775	(1)	(1)	(1)	(1)	206,711	1,416,812	1,549,246	12,482,106
Oklahoma	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
Oregon	3,940	21,524	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3,940	21,524
Pennsylvania	190,553	1,225,629	87,453	732,900	304,220	2,048,664	95,005	619,328	(1)	(1)	31,221	222,063	(1)	(1)	127,235	958,614	1,003,039	7,263,779
Puerto Rico	2,207	25,250	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)	8,159	114,728
Rhode Island	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
South Dakota	-----	-----	923	9,643	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)	30	300	(1)	(1)
Tennessee	(1)	(1)	37,131	283,753	45,170	206,559	75,575	391,799	-----	-----	7,217	40,490	18,213	110,682	(1)	(1)	239,528	1,354,642
Texas	(1)	(1)	31,829	294,187	(1)	(1)	16,566	93,727	-----	-----	-----	-----	13,903	114,008	13,605	117,051	77,783	632,099
Utah	-----	-----	6,324	67,467	49,087	274,534	-----	-----	(1)	(1)	-----	-----	314	4,706	(1)	(1)	56,221	352,306
Vermont	6,461	28,408	14,160	112,182	(1)	(1)	26,075	189,069	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	67,824	479,219
Virginia	33,692	206,201	27,935	186,069	56,203	320,524	25,785	161,653	-----	-----	1,496	9,106	7,407	51,553	71,775	424,175	224,293	1,359,281
Washington	4,217	30,216	13,793	193,955	(1)	(1)	30,105	289,505	-----	-----	-----	-----	(1)	(1)	(1)	(1)	62,309	656,363
West Virginia	22,711	81,350	7,627	48,814	155,540	806,965	(1)	(1)	(1)	(1)	(1)	(1)	12,338	72,147	(1)	(1)	372,677	2,350,362
Wisconsin	2,213	13,624	34,106	276,360	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	19,900	198,091	79,077	659,324
Undistributed[2]	28,422	196,033	83,262	779,652	165,793	1,040,211	163,855	1,138,195	417,793	3,547,397	40,945	265,947	116,286	804,331	540,986	3,040,140	424,455	2,799,292
	382,727	2,387,045	1,065,599	9,259,118	1,366,899	8,070,180	677,116	4,234,772	1,069,887	9,111,172	93,157	649,002	319,244	2,072,807	1,104,787	7,157,066	6.079,416	42,941,162

[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

Lime and other liming materials used in agriculture.—Because of its quick reaction and consequent speedy effect in promoting plant growth, lime is widely used as a soil conditioner and fertilizer. The same effect may be obtained by using finely divided uncalcined limestone or shells, but the action is slower. However, because of the low cost and ready availability of uncalcined limestone, it is used much more extensively than lime. The following table shows the quantities and values of various liming materials used in agriculture.

The effective lime content shown in this table has been calculated upon the basis of average percentages used by the National Lime Association, as follows: 85 percent of the quicklime (including lime from oystershells), 70 percent of the hydrated lime, 47 percent of the pulverized uncalcined limestone and oystershells, and 42 percent of the calcareous marl.

Agricultural lime and other liming materials sold or used by producers in the United States, 1940–41, by kinds

Kind	1940				1941			
	Short tons		Value		Short tons		Value	
	Gross	Effective lime content [1]	Total	Average	Gross	Effective lime content [1]	Total	Average
Lime from limestone:								
Quicklime	165, 764	140, 900	$802, 677	$4 84	[2] 161, 063	[2] 136, 900	[2] $866, 721	[2] $5.38
Hydrated	199, 059	139, 340	1, 281, 785	6. 44	[2] 221, 664	[2] 155, 170	[2] 1,520, 324	[2] 6. 86
Lime from oystershells	[3] 29, 271	24, 880	[3] 208, 551	7. 12	(2)	(2)	(2)	(2)
Oystershells (crushed)[3]	92, 213	43, 340	253, 776	2 75	[4] 117,531	[4] 55, 240	[4] 411, [illegible]12	[4] 3. 50
Limestone	8, 724, 160	4, 100, 360	9, 910, 373	1. 14	11, 909, 640	5, 597, 530	14, 395, 831	1. 21
Calcareous marl	25, 516	10, 720	42, 481	1. 66	183, 009	76, 860	175, 393	. 96

[1] Method of computing lime content described in preceding text.
[2] Lime from oystershells included with "lime from limestone"
[3] Figures supplied by Fish and Wildlife Service.
[4] Preliminary figure.

Building lime.—Building-lime sales as a whole and by States are shown in preceding tables. Sales of building lime by kind or class and the value per ton in 1941 were as follows: Finishing lime, 452,522 short tons, $9.29; mason's lime, 464,564 tons, $8.20; for manufacture of prepared masonry mortars, 64,572 tons, $6.46; and for unspecified purposes, 83,941 tons, $9.87.

Chemical and industrial lime.—The use of lime in manufacturing and processing industries has attained great importance. Lime is regarded as an indispensable ingredient in hundreds of products and is deemed necessary as an active reagent in scores of important processes. These uses have been discussed largely from a statistical angle in a recent report [1] of the Bureau of Mines.

One of the important industrial uses is as a furnace flux and for other metallurgical applications. The quantities and average values per ton of lime applied to various metallurgical uses in 1941 were as follows: Flux for open-hearth steel manufacture, 998,968 short tons, $5.81; flux for electric steel furnaces, 52,883 tons, $7.05; flux for

[1] Bowles, Oliver, and Jensen, M. S., Limestone and Dolomite in the Chemical and Processing Industries: Bureau of Mines Inf. Circ. 7169, 1941, 15 pp.

smelting nonferrous metals, 76,112 tons, $5.86; ore concentration (including cyanidation), 159,634 tons, $5.81; wire drawing, 7,025 tons, $7.74; other uses (including unspecified), 72,277 tons, $6.40.

The quantity and value of chemical and industrial lime listed as "Other uses" in a previous table were reported for 1941 as follows:

Chemical and industrial lime sold or used by producers in the United States for "Other uses" in 1941

Use	Short tons	Value	Use	Short tons	Value
Acid neutralization	1,739	$14,222	Insecticides, fungicides, and disinfectants	81,955	$587,567
Asphalts and other bituminous material	2,743	23,112	Magnesia	51,256	373,909
Bleach, liquid and powder (excludes bleach for paper manufacture)	14,687	100,579	Paints (calcimine, pigments, etc.)	45,513	258,298
Brick, sand-lime and slag	21,503	156,081	Petroleum refining	34,696	252,010
Brick, silica (refractory)	24,966	168,819	Polishing and buffing compounds	3,922	97,987
Calcium carbide and cyanamide	132,351	683,410	Rubber	3,058	22,346
Calcium carbonate, precipitated	9,677	69,994	Salt refining	1,956	12,593
Chromates and bichromates	18,277	108,649	Sewage and trade-wastes treatment	38,256	245,115
Coke and gas (gas purification and plant byproducts)	22,011	139,499	Textiles	1,091	8,210
Food products:			Varnish	864	5,888
Creameries and dairies	1,171	19,877	Wood distillation	2,557	24,106
Gelatin	4,846	32,718	Undistributed [2]	156,119	777,442
Other [1]	887	7,658	Unspecified	204,952	1,346,218
Glue	12,005	83,580		897,059	5,654,764
Grease, lubricating	4,001	34,787			

[1] Includes lime used in chocolate, cocoa, fruit juices, phosphate baking powders, and other food products not specified.

[2] Includes acids (unspecified), alcohol, alkalies (ammonium, potassium, and sodium compounds), amiesite road surfacing, bromine, calcium phosphate, cement manufacturing, explosives, fertilizer filler, heavy chemicals, magnesia from sea water, medicines and drugs, neutralization of phosphate, nicotine, poultry feed, precipitation of phosphate in vanadium manufacture, retarder, rock wool, soap and fat, Spanish whiting, starfish control, sulfur, tobacco, and wool pullers.

HYDRATED LIME

If quicklime (high-calcium) is exposed to water, it reacts readily to form hydrated lime according to the following equation $CaO+H_2O=Ca(OH)_2$. The reaction is accompanied by evolution of heat. The combination of lime and water upon a quantitative basis is as follows: 56 pounds of lime unites with 18 pounds of water to form 74 pounds of hydrated lime or "hydrate," as it is commonly termed. The user of hydrated lime may object to buying 18 pounds of water with every 56 pounds of quicklime and may on this account decide to buy quicklime and hydrate it himself. Some users do this, but in general the hydrating process is too precise an operation to be performed without adequate equipment or skill. For instance if too little water is added, part of the lime remains unslaked, which may cause trouble later. Unhydrated particles in a wall plaster, for example, will hydrate slowly, causing "popping" of the plaster. If, on the other hand, too much water is added, a damp, sticky, or muddy hydrate will be formed. Many lime companies are equipped with mechanical hydrators that automatically supply the exact quantity of water needed and agitate the product so thoroughly that virtually complete hydration of high-calcium lime is accomplished. Dolomitic (high-magnesium) lime hydrates less readily than high-calcium lime, therefore its preparation as a hydrate involves additional problems. Some lime producers have found it necessary to employ special equipment to attain adequate

hydration of dolomitic lime. Most users of hydrated lime prefer the product sold by lime producers.

Hydrated lime was reported by 166 plants for 1941 (161 reported for 1940). The increase from 1,385,825 short tons in 1940 to 1,590,159 in 1941 was accompanied by an increase of 18 cents a ton in average value. Three States—Ohio, Pennsylvania, and Missouri—produced 61 percent of the total. Production for a series of years and by States appears in the accompanying tables.

Hydrated lime sold or used by producers in the United States, 1937–41

Year	Plants in operation	Short tons	Value	
			Total	Average
1937	170	1,301,333	$10,344,470	$7.95
1938	165	1,169,804	9,111,575	7.79
1939	159	1,318,053	10,124,241	7.68
1940	161	1,385,825	10,522,578	7.59
1941	166	1,590,159	12,354,798	7.77

Hydrated lime sold or used by producers in the United States, 1940–41, by States

State	1940		1941	
	Short tons	Value	Short tons	Value
Alabama	23,470	$187,803	31,370	$224,609
California	22,898	222,199	25,540	261,622
Florida	12,129	127,528	12,214	119,713
Georgia	13,737	91,932	9,748	70,755
Hawaii	(1)	(1)	8,665	136,475
Illinois	26,092	198,194	39,496	282,634
Indiana	20,375	126,503	24,645	158,618
Maryland	22,730	116,006	24,826	169,349
Massachusetts	39,144	292,724	41,166	321,515
Michigan	10,772	87,386	14,464	107,493
Missouri	153,213	878,521	179,425	1,054,833
New York	14,089	102,423	16,784	112,176
Ohio	494,057	4,168,505	539,939	4,661,687
Pennsylvania	217,774	1,529,138	250,733	1,955,757
South Dakota	(1)	(1)	698	7,393
Tennessee	44,096	328,215	45,304	348,539
Texas	22,822	231,459	27,415	262,349
Virginia	59,425	378,790	74,810	486,488
Washington	9,243	86,974	10,803	96,474
West Virginia	36,828	234,912	48,028	254,156
Wisconsin	10,808	81,485	(1)	(1)
Other States [2]	132,123	1,051,881	164,086	1,262,163
	1,385,825	10,522,578	1,590,159	12,354,798

[1] Included under "Other States."
[2] 1940 Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, Oklahoma, Rhode Island, South Dakota, Utah, and Vermont. 1941: Arizona, Arkansas, Colorado, Connecticut, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Oklahoma, Puerto Rico, Rhode Island, Utah, Vermont, and Wisconsin.

Uses.—Hydrated lime is utilized in many ways. Increased sales in all important categories were reported in 1941. The largest increases were for sugar refineries (52 percent) and tanneries (38 percent).

Hydrated lime sold or used by producers in the United States, 1940–41, by uses

Use	1940		1941	
	Short tons	Value	Short tons	Value
Agricultural	199, 059	$1, 281, 785	221, 664	$1, 520, 324
Building	723, 888	6, 002, 015	780, 328	6, 665, 319
Chemical and industrial:				
Glassworks	2, 229	13, 925	2, 501	16, 163
Metallurgy	53, 554	351, 945	61, 174	392, 203
Paper mills	39, 644	262, 234	47, 098	312, 470
Sugar refineries	11, 603	137, 345	17, 611	199, 186
Tanneries	32, 259	233, 661	44, 484	324, 048
Water purification	126, 967	884, 199	158, 560	1, 108, 885
Other uses	196, 622	1, 355, 469	256, 739	1, 816, 200
	462, 878	3, 238 778	588, 167	4 169, 155
Total hydrated lime	1, 385, 825	10, 522, 578	1, 590, 159	12, 354, 798

TRENDS IN PRINCIPAL USES

All major uses of lime increased during 1941, the greatest gain (35 percent) being for chemical and industrial purposes. Agricultural and building uses each gained 5 percent.

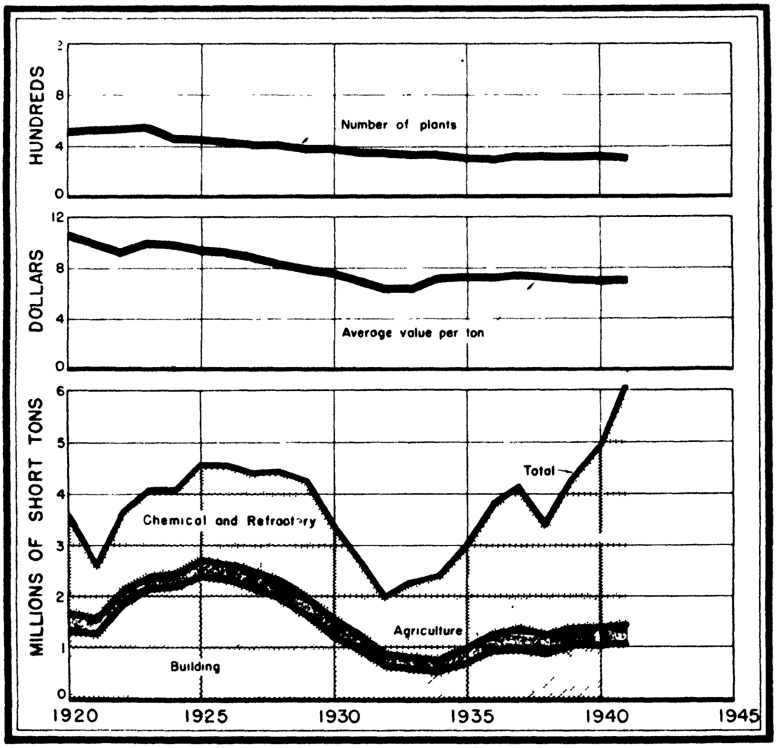

FIGURE 2.—Trends in number of active lime plants, average value per ton, and principal uses, 1920–41.

The gains in metallurgical and refractory lime were not consistent with each other—37 and 23 percent, respectively. The increase in chemical and industrial applications was accentuated further by large gains in the use of lime by manufacturers of calcium carbide and insecticides (50 percent over 1940). Trends in the principal uses over a 22-year period are indicated in figure 2.

A graphic comparison of the total quantity of lime consumed in building with new construction activity for the past 22 years is shown in figure 3.

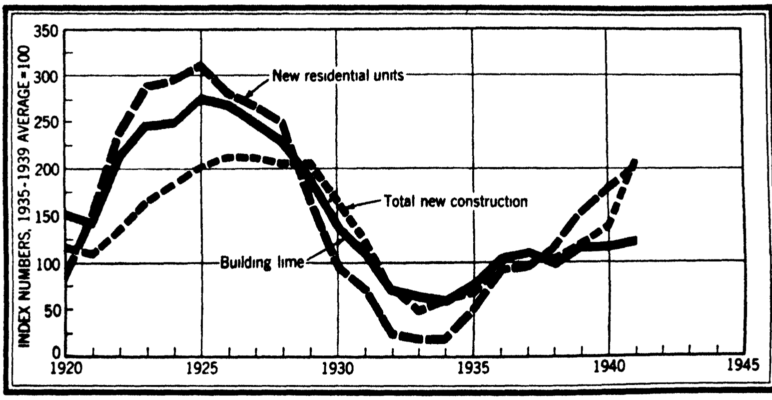

FIGURE 3.—Building-lime (quick and hydrated) value compared with total new construction and residential building, 1920–41. Data for new construction, 1920–41, from Department of Commerce. Data for new residential dwelling units (nonfarm) from Bureau of Labor Statistics.

Consumption of metallurgical lime has increased each year since 1932, except for the recession in 1938 (see fig. 4). The rate of increase has been greater in the past 3 years than the gain in steel-ingot output would indicate. This may be due in part to an increase in the use

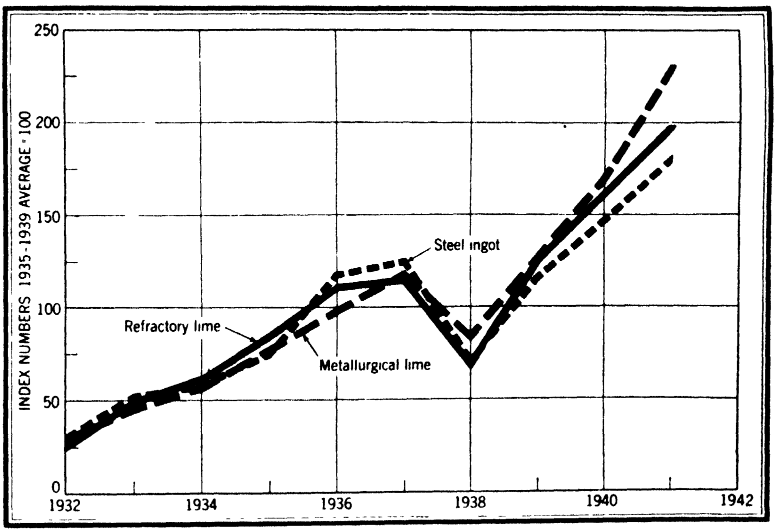

FIGURE 4.—Sales of metallurgical lime and refractory lime (dead-burned dolomite) compared with steel-ingot production, 1932–41. Index numbers for steel ingots computed by Federal Reserve Board from data of American Iron and Steel Institute.

of higher-phosphorus iron ores, as indicated earlier, and possibly to a decrease in the amount of scrap iron and steel used. The gain in production of metallurgical lime was accompanied by a less spectacular gain (20 percent from 1940 to 1941) in limestone for flux. Data on raw dolomite are given in the chapter on Stone.

SHIPMENTS

TOTAL SHIPMENTS

Sales, shipments, and supplies of lime available for consumption in continental United States, by States and groups of States that comprise approximate freight zones, are listed in the two tables that follow. Reshipments beyond original destinations are not indicated, and foreign shipments and tonnages for which distribution is not recorded are omitted.

Production of lime exceeds apparent consumption in 11 States, but only Ohio, Missouri, and Tennessee show large tonnages moving out of the State in excess of inward-moving shipments. Four leading States—Pennsylvania, New York, Illinois, and Michigan—consumed more than they produced.

Lime supplies available in continental United States in 1941, by States, in short tons

State	Sales by producers	Shipments from State [1]	Shipments into State	Supply			
				Hydrated	Quicklime	Total	Pounds per capita [2]
Alabama	306,836	84,829	37,729	13,747	245,989	259,736	183.4
Arizona	58,146	27,016	1,299	3,350	29,079	32,429	129.9
Arkansas	(3)	(3)	(3)	5,064	15,961	21,025	21.6
California	122,375	10,982	34,032	34,851	110,574	145,425	42.1
Colorado	(3)	(3)	(3)	4,052	12,629	16,681	29.7
Connecticut	(3)	(3)	(3)	18,684	22,935	41,619	48.7
Delaware	------	------	39,302	14,169	25,133	39,302	294.9
District of Columbia	------	------	18,272	15,851	2,421	18,272	55.1
Florida	23,265	------	44,831	28,407	39,689	68,096	71.8
Georgia	12,515	1,875	67,925	34,928	43,637	78,565	50.3
Idaho	120	------	2,651	1,082	1,689	2,771	10.5
Illinois	246,574	112,854	258,603	88,060	304,263	392,323	99.3
Indiana	106,407	84,127	192,367	37,754	176,893	214,647	125.2
Iowa	------	------	63,489	15,742	47,747	63,489	50.0
Kansas	------	------	31,127	14,734	16,393	31,127	34.6
Kentucky	------	------	101,368	15,833	85,535	101,368	71.2
Louisiana	(3)	(3)	(3)	14,391	178,021	192,412	162.8
Maine	(3)	(3)	(3)	8,966	71,431	80,397	189.8
Maryland	65,624	14,050	118,743	53,957	116,360	170,317	187.0
Massachusetts	106,336	81,628	47,089	32,985	38,812	71,797	33.2
Michigan	55,447	25,165	221,248	77,536	173,994	251,530	95.7
Minnesota	(3)	(3)	(3)	15,747	46,586	62,333	44.6
Mississippi	------	------	13,480	6,004	7,476	13,480	12.3
Missouri	736,200	471,753	21,061	96,770	188,738	285,508	150.9
Montana	(3)	------	(3)	3,088	22,891	25,979	92.9
Nebraska	------	------	8,809	6,878	1,931	8,809	13.4
Nevada	(3)	(3)	(3)	29,197	5,267	34,464	625.2
New Hampshire	------	------	12,058	3,688	8,370	12,058	49.1
New Jersey	(3)	(3)	(3)	103,133	47,577	150,710	72.4
New Mexico	(3)	------	(3)	2,255	23,536	25,791	97.0
New York	62,339	8,225	340,960	137,446	257,628	395,074	58.6
North Carolina	(3)	(3)	(3)	31,349	64,373	95,722	53.6
North Dakota	------	------	5,872	5,811	61	5,872	18.3
Ohio	1,549,246	1,032,426	161,023	135,671	542,172	677,843	196.2
Oklahoma	(3)	(3)	(3)	16,654	29,657	46,311	39.6
Oregon	3,940	------	13,459	2,448	14,951	17,399	31.9
Pennsylvania	1,003,039	334,098	436,611	209,007	896,545	1,105,552	223.3
Rhode Island	(3)	(3)	(3)	6,289	6,881	13,170	36.9
South Carolina	------	------	26,815	15,224	11,591	26,815	28.2
South Dakota	(3)	(3)	(3)	3,228	3,214	6,442	20.0
Tennessee	239,528	197,329	11,653	28,155	25,697	53,852	36.9
Texas	77,783	15,330	3,808	25,680	40,581	66,261	20.6
Utah	56,221	710	1,295	4,316	52,490	56,806	206.4
Vermont	67,824	61,689	1,219	1,296	6,058	7,354	40.9
Virginia	224,293	162,039	71,771	49,101	84,924	134,025	100.1
Washington	62,309	14,559	2,578	8,996	41,332	50,328	58.0
West Virginia	372,677	333,441	200,969	28,958	211,247	240,205	252.8
Wisconsin	79,077	38,976	60,934	29,636	71,399	101,035	64.4
Wyoming	------	------	1,292	946	346	1,292	10.3
Undistributed [4]	424,455	98,720	487,321	------	------	------	------
	6,062,576	[1] 3,211,821	3,163,063	1,541,114	4,472,704	6,013,818	92.3

[1] Includes 48,758 tons unclassified as to destination.
[2] Per capita figures based upon latest available estimates of population made by Bureau of the Census.
[3] Included under "Undistributed."
[4] Includes items entered as "(3)."

Lime shipped (supply) in continental United States in 1941, by origin and destination of shipments, in short tons

Destination	Origin: Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia			Alabama, Louisiana, Tennessee		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	287,332	884,187	1,171,519	8,256	48,085	56,341	180	305	485	1,716	20,554	22,270	1,770	632	2,402
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	178,256	333,967	512,223	334,332	1,041,410	1,375,742	25,381	53,088	78,469	18,009	84,093	102,102	959	15,417	16,376
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	25 046	1,690	26,736	3,975	50,393	54,368	41,457	101,443	142,900	275	910	1,185	-	-	-
Florida, Georgia, North Carolina, South Carolina, Virginia	53,725	4,317	58,042	9,270	18,413	27,683	-	45	45	64,788	58,557	123,345	30,506	148,119	178,625
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	28,229	67,886	96,115	110	122	232	-	-	-	800	-	800	36,871	407,515	444,386
Arkansas, Kansas, Nebraska, Oklahoma, Texas	3,405	760	4,165	-	-	-	-	-	-	-	-	-	-	-	-
Iowa, Minnesota, Missouri, Wisconsin	39,978	39,058	79,036	-	-	-	-	-	-	-	3	3	-	-	-
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	1,607	3,190	4,797	30	-	30	-	-	-	-	-	-	-	-	-

Destination	Origin: Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	27	91	118	39,740	243,468	283,208	-	-	-	339,021	1,197,322	1,536,343
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	18	-	18	5,566	28,936	34,502	-	-	-	562,521	1,556,911	2,119,432
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	-	-	-	1,155	51	1,206	-	-	-	71,908	154,487	226,395
Florida, Georgia, North Carolina, South Carolina, Virginia	-	-	-	720	14,763	15,483	-	-	-	159,009	244,214	403,223
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	5,033	26,170	31,203	7,087	41,025	48,112	-	-	-	78,130	542,718	620,848
Arkansas, Kansas, Nebraska, Oklahoma, Texas	43,201	82,905	126,106	22,404	20,858	43,262	-	-	-	69,010	104,523	173,533
Iowa, Minnesota, Missouri, Wisconsin	460	751	1,211	117,457	314,658	432,115	-	-	-	157,895	354,470	512,365
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	2,069	2,416	4,485	10,208	7,129	17,337	89,706	305,324	395,030	103,620	318,059	421,679

HYDRATED LIME

Apparent consumption of hydrated lime in the Middle Atlantic States has been high in recent years. During 1941 it rose in all regions, but the percentage of increase from 1940 to 1941 was greatest in the Upper Mississippi Valley States.

Shipments of hydrated lime from plants in continental United States and in Ohio in 1941, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (percent)	Short tons	Distribution (percent)	Percent of total shipments
Illinois, Indiana, Michigan, Ohio	339,021	21.5	231,979	43.0	68.4
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	562,521	35.7	176,533	32.7	31.4
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	71,908	4.5	25,046	4.7	34.8
Florida, Georgia, North Carolina, South Carolina, Virginia	159,009	10.1	53,725	10.0	33.8
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	78,130	4.9	23,902	4.4	30.6
Arkansas, Kansas, Nebraska, Oklahoma, Texas	69,010	4.4	3,376	.6	4.9
Iowa, Minnesota, Missouri, Wisconsin	157,895	10 0	23,415	4.3	14.8
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	103,620	6.6	1,177	.2	1.1
Undistributed	36,469	2.3	786	.1	2 2
	1,577,583	100.0	539,939	100.0	34.2

PRICES

Reversing the downward trend of the preceding 3 years, 1941 prices increased in all major categories over 1940. The increase in value of agricultural lime was greatest—9 percent. This price is the highest since 1938. Building lime increased 3 percent and came within 1 cent of the highest price during the past decade (that in 1935). The price of refractory lime rose to a new high, with a 7-percent increase. Values for the past 10 years are compared in the following table.

Average values of lime according to uses, 1932–41 [1]

Use	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941
Agricultural	\$5 59	\$5.36	\$6 66	\$6.73	\$6.26	\$6.74	\$6.52	\$6.11	\$5 71	\$6.24
Building	6 45	7 18	8 33	8.70	8.52	8.66	8.38	8.56	8 45	8.69
Chemical and industrial	6.13	5.73	6 52	6 50	6.42	6.47	6.53	6 23	6.20	6.23
Refractory	7 78	7.89	8.31	8.32	8 19	8.45	8.44	8.11	7.98	8.52
Total	6.28	6.28	7.16	7.28	7.18	7.30	7.21	7 06	6.95	7.06
Hydrated	6 30	6.69	7.63	7.90	7.77	7.95	7.79	7.68	7.59	7.77

[1] Value at place of manufacture, exclusive of containers.

FUEL RATIOS

A study of lime : fuel ratios of lime plants reporting for 1939 was made by Moyer [2] to show the comparative efficiency of various kinds of fuel used in the three general types of kilns. This study indicated that pot kilns were most efficient and rotary types least efficient.

[2] Moyer, Forrest T., Lime:Fuel Ratios of Commercial Lime Plants in 1939: Bureau of Mines Inf. Circ. 7174, 1941, 9 pp.

Shaft kilns using coke showed the highest lime : fuel ratio of any single type.

The accompanying table represents similar studies of reporting plants in 1940 and 1941. For each year, 60 percent of the active plants reported fuel ratios, representing over 75 percent of the total lime produced. A significant feature is the definite uptrend in efficiency of bituminous coal in shaft kilns and in rotary kilns producing dead-burned dolomite. Paradoxically, rotary kilns using bituminous coal, aside from those used to burn refractory dolomite, show a drop in lime : fuel ratio. In 1940 the greatest efficiency was attained by shaft kilns using coke, in 1941 by shaft kilns using anthracite. Kilns of all types using wood and oil decreased markedly in efficiency during 1941.

Lime: fuel ratios, by type of kiln and kind of fuel, for reporting plants, 1940–41

1940

Type of kiln	Kind of fuel	Reporting: Operators	Reporting: Plants	Number of kilns	Lime [1] produced (short tons)	Fuel used: Quantity [2]	Fuel used: Unit	Lime : fuel ratio [3]: Range reported	Lime : fuel ratio [3]: Calculated average
Pot	Anthracite	3	3	33	20,295	10,782,537	Pounds	3.00-5.40	3.76
	Bituminous coal	8	8	30	22,602	12,129,034	do	3.00-5.00	3.73
	Coke	12	12	57	79,227	42,149,871	do	3.00-6.00	3.76
	Wood	3	3	7	10,466	5,098	Cords	3,900-5,000	4,105.92
Shaft	Anthracite	3	3	7	18,235	9,542,889	Pounds	3.22-8.00	3.82
	Bituminous coal	51	54	399	1,078,038	679,041,096	do	1.33-6.00	3.18
	Coke	4	4	14	30,313	14,175,338	do	2.00-8.00	4.27
	Producer gas	11	11	72	251,795	125,882,489	Pounds of bit. coal.	3.25-4.87	4.00
	Natural gas	15	15	64	218,307	1,366,022	M cu ft	225-420	319.62
	Fuel oil	3	4	14	27,794	33,906	Barrels	1,400-2,350	1,639.48
	Wood	21	22	77	153,314	65,345	Cords	2,600-8,000	4,692.38
Rotary	Bituminous coal	10	11	18	561,416	312,803,653	Pounds	2.00-5.00	3.59
	Producer gas	4	4	6	134,635	101,725,846	Pounds of bit. coal.	2.60-3.00	2.65
	Natural gas	6	6	8	110,750	883,697	M. cu. ft	190-364	250.67
	Fuel oil	6	7	13	114,622	158,276	Barrels	1,000-1,700	1,448.38
REFRACTORY (DEAD-BURNED) DOLOMITE									
Rotary	Bituminous coal	6	8	24	671,290	572,096,024	Pounds	2.00-2.55	2.34

1941

Type of kiln	Kind of fuel	Reporting: Operators	Reporting: Plants	Number of kilns	Lime [1] produced (short tons)	Fuel used: Quantity [2]	Fuel used: Unit	Lime : fuel ratio [3]: Range reported	Lime : fuel ratio [3]: Calculated average
Pot	Anthracite	8	8	51	31,855	18,595,254	Pounds	1.14-4.1	3.43
	Bituminous coal	7	7	29	24,329	12,259,667	do	3.00-6.00	3.97
	Coke	11	12	59	149.969	76,996,506	do	2.75-6.00	3.90
	Wood	4	4	10	17,247	8,941	Cords	2,000-5,000	3,857.95
Shaft	Anthracite	3	3	10	14,743	6,694,285	Pounds	4.00-8.00	4.40
	Bituminous coal	50	54	429	1,253,868	724,524,319	do	1.47-7.00	3.46
	Coke	5	6	18	36,231	18,634,608	do	2.00-7.00	3.89
	Producer gas	10	10	81	265,382	127,232,788	Pounds of bit. coal.	3.45-4.87	4.17
	Natural gas	16	17	72	322,601	2,101,943	M cu. ft	250-400	306.95
	Fuel oil	5	7	17	39,371	53,029	Barrels	1,200-2,350	1,484.86
	Wood	17	18	75	163,247	70,938	Cords	2,000-8,000	4,602.53
Rotary	Bituminous coal	12	14	26	865.221	527,496,602	Pounds	2.00-5.00	3.28
	Natural gas	8	8	20	368,782	3,570,380	M cu. ft	120-400	206.58
	Fuel oil	7	8	15	150,340	214,287	Barrels	1,250-1,700	1,403.14
REFRACTORY (DEAD-BURNED) DOLOMITE									
Rotary	Bituminous coal	6	10	27	923,845	751,816,953	Pounds	2.00-3.43	2.46

[1] Quantity of quicklime sold plus calculated equivalent quicklime contained in hydrated lime sold from reporting plants during year covered.
[2] Calculated from quicklime production and reported lime : fuel ratios.
[3] Reported and calculated as pounds of lime calcined by a unit quantity of fuel.

The quantity of lime burned by each of the several fuels increased in 1941 over 1940. The largest gain was in the use of natural gas, which more than doubled in importance. The tonnage of lime burned by bituminous coal decreased from 78 percent of the total in 1940 to 72 percent in 1941. Oil, wood, coke, and anthracite were used as fuels in burning 13 percent of the total lime in 1940 and 1941.

SIZE OF COMPANIES

A study of active commercial lime companies, comparing volumes of sales and numbers of companies in similar size groups, was made by Bowles and Coons in 1939.[3] This study indicated that companies producing less than 25,000 tons annually were decreasing in number and total output, whereas those producing more than 25,000 tons were increasing in number and output. The trend toward larger and fewer companies was interrupted during the early 1930's but was resumed a few years later. The accompanying table shows that the larger size groups gained greatly from 1936 to 1941. Companies producing over 50,000 tons showed the most spectacular increases in the last 5-year period, doubling in number and in production. In 1941 more than two-thirds of the total lime output of the country was reported by companies producing 50,000 or more tons.

Comparison of number of companies and sales of lime (including dead-burned dolomite) in the United States in 1926, 1931, 1936, and 1941, by size groups

Size group (short tons)	1926		1931		1936		1941	
	Companies	Short tons	Companies	Short tons	Companies	Short tons	Companies	Short tons
Less than 1,000	156	33, 385	134	35, 966	86	24, 414	77	24, 023
1,000 and less than 5,000	80	207, 658	76	198, 842	69	181, 384	60	154, 435
5,000 and less than 10,000	49	359, 148	36	256, 792	32	239, 137	37	265, 543
10,000 and less than 25,000	58	919, 182	32	527, 596	35	541, 610	33	516, 457
25,000 and less than 50,000	20	727, 000	20	707, 822	24	839, 491	26	914, 391
50,000 and less than 100,000	14	1, 018, 122	7	505, 663	8	504, 531	21	1, 449, 545
100,000 and over	9	1, 295, 903	4	474, 933	9	1, 418, 816	12	2, 755, 022
	386	4, 560, 398	309	2, 707, 614	263	3, 749, 383	266	6, 079, 416

NEW DEVELOPMENTS

It is claimed that a new type of center burner now in use in shaft kilns gives increased output, better quality of lime, and higher fuel efficiency. Its greatest advantage, however, is its ability to utilize small stone, which is generally discarded as waste at plants where lime is burned in shaft kilns.

Unit coal pulverizers that discharge directly to rotary kilns—a type of equipment used at many cement plants—are now employed at lime plants.

Processes of pressure hydration have been perfected whereby 85 percent or more of the magnesia in dolomite is hydrated. The superhydrate, after supplementary treatment which varies in different plants, has unusual plasticity and sand-carrying capacity. Superhydration is especially advantageous in lime used for sand-lime brick manufacture and for wall plaster.

[3] Bowles, Oliver, and Coons, A. T., Graphic Survey of the Lime Industry, 1910–38: Bureau of Mines Inf. Circ. 7088, 1939, 8 pp.

Fundamental research is in progress at the University of Illinois in cooperation with the National Lime Association, involving X-ray work as well as studies by means of an electron microscope, on the properties of calcium and magnesium oxides and hydroxides.

Further progress has been made with the use of lime on stabilized roads. Hydrated lime mixed thoroughly with gumbo clay, wetted and compacted with a tamping roller, is said to provide a satisfactory base upon which an ordinary concrete or asphalt topping may be placed.

Bureau of Mines Information Circular 6884, Lime, published in 1936, describing the principal features of the lime industry, was revised and republished [4] in 1941.

FOREIGN TRADE [5]

Because of restrictions on publication of foreign trade data, figures for 1941 imports and exports are confined to the first 9 months of the year.

IMPORTS

The following tables show imports by kind for a series of years and by country of origin and customs district for 1940 and 1941.

Lime imported for consumption in the United States, 1937–41

Year	Hydrated lime		Other lime		Dead-burned dolomite [1]		Total	
	Short tons [2]	Value	Short tons [2]	Value	Short tons	Value	Short tons	Value
1937	1,174	$13,885	7,614	$76,720	9,083	$231,084	17,871	$321,689
1938	858	10,001	5,960	56,202	2,875	67,340	9,693	133,543
1939	1,148	11,242	6,546	60,660	186	4,260	7,880	76,162
1940	712	6,558	8,493	75,330			9,205	81,888
1941 (Jan.–Sept.)	555	6,364	8,610	72,496			9,165	78,860

[1] Classification reads "Dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime."
[2] Includes weight of immediate container.

Lime imported for consumption in the United States, 1940–41, by countries and customs districts [1]

Country	Customs district	1940		1941 (Jan.–Sept.)	
		Short tons [2]	Value	Short tons [2]	Value
Canada	Florida			15	$120
	Los Angeles	529	$4,913	300	2,852
	Maine and New Hampshire	53	546	14	98
	Michigan	5	68		
	St. Lawrence	92	362	7	184
	San Francisco	3,865	34,410	3,447	31,825
	Vermont			2	43
	Washington	4,641	41,039	5,380	43,738
Japan	Washington	(3)	11		
Sweden	San Francisco	3	120		
United Kingdom	New York	17	419		
		9,205	81,888	9,165	78,860

[1] Exclusive of dead-burned basic refractory material.
[2] Includes weight of immediate container.
[3] Less than 1 ton.

[4] Bowles, Oliver, and Banks, D. M. (revised by Duncan McConnell), Lime. Bureau of Mines Inf. Circ. 6884R, 1941, 48 pp.
[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

EXPORTS

Exports of lime in the past 5 years are indicated in the following table.

Lime exported from the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	11,300	$122,895	1940	31,912	$311,619
1938	13,222	121,662	1941 (Jan.-Sept.)	32,444	318,541
1939	21,477	236,497			

CLAYS

By Paul M. Tyler and A. Linn [1]

SUMMARY OUTLINE

GENERAL SUMMARY

Shipments of almost every variety of clay from domestic mines again made new high records in 1941. Even before the World War of 1914–18, clay mining had become a substantial industry in the United States. In fact, during the 5 years immediately preceding the outbreak of hostilities in 1914, annual shipments of merchant clay averaged 2,381,965 short tons. This sizable tonnage, however, was worth only $3,736,487, and its low unit value testified that most of it was crude or ill prepared. Papermakers, pottery manufacturers, and other consumers of the better qualities of clay purchased their requirements abroad, and not until imports from overseas were endangered by submarines did American producers make serious efforts to improve their clays. Pioneered by the Bureau of Mines, beneficiation methods were worked out for refining Georgia clays so that they could be substituted successfully for imported clays.

During the interwar period, great progress was made in clay preparation, and the United States became potentially independent of foreign sources. The importation of high-grade clays continued but eventually was limited to certain localities where relative transportation costs made them cheaper or to certain branches of the ceramics industry (notably the manufacture of sanitary ware and semivitreous dinnerware) where changes in batch formulation are impeded by the excessive cost of possible spoilage compared with potential savings in cost of raw materials. Resumption of hostilities in Europe and the growing menace of submarines after September 1939 speeded the trend to displace imported with improved domestic clays. Meanwhile the rapidly expanding use of paper and the larger proportions of clay relative to other ingredients employed in the manufacture of paper, rubber, and other products increased the aggregate demand, so that the flow of kaolin and other high-grade clay from American mines has increased year after year. In 1941

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce. Domestic figures for fuller's earth compiled by R. W. Metcalf, of the Bureau of Mines.

the shipments of all kinds of domestic clay, excluding fuller's earth, totaled 7,018,056 tons valued at $25,193,893. Although this is only three times the 1909–13 annual average quantity it was worth almost seven times as much, the unit value being $3.59 a ton in 1941 compared with $1.57 before the first World War.

Bureau of Mines figures for clay shipments cover only a small fraction of the clay mined in the United States. No attempt is made to include the clay burned into common brick, build ng tile, sewer pipe, and other clay products at integrated plants situated at the mines or pits. On the assumption that it takes 3 tons of clay to make 1,000 brick, the production of common brick alone required over 22,000,000 tons of raw clay in the peak year 1925; notwithstanding diminished demand, structural clay products even now require from ten to fifteen million tons of raw clay a year. Only a little over half the total consumption of fire clay appears in the Bureau of Mines figures as shipments, because nearly half of the total (3,275,021 tons in 1941) is burned directly into refractories at pitside plants. About 4,000,000 tons of additional clay or shale are used in portland-cement manufacture, and most of this escapes inclusion in the annual clay statistics because it was neither sold nor shipped away from the mine. A rough calculation shows that shipments of what may be termed "merchant" clay comprised in 1941 only 20 percent and in some years not more than 10 percent of the total clay or shale mined in the United States.

Salient statistics of the clay industry in the United States, 1925–41

	1925–29 (average)	1930–34 (average)	1935–39 (average)	1940	1941
Domestic clay sold or used by producers:					
Kaolin, china clay..........short tons..	453,618	431,932	654,147	833,450	1,087,848
Ball clay..........do....	116,127	70,299	108,525	140,707	198,445
Fire clay (including stoneware clay) short tons..	2,898,576	1,487,364	2,175,309	2,765,247	4,167,567
Bentonite..........do....	(1)	84,762	188,385	251,032	354,028
Fuller's earth..........do....	261,640	259,354	204,529	146,568	207,446
Miscellaneous clays..........do....	[1] 575,708	305,973	360,602	710,515	1,210,168
Total domestic:					
Quantity..........do....	4,305,669	2,639,684	3,691,497	4,847,519	7,225,502
Value..........	$17,568,812	$10,977,776	$15,455,392	$19,633,568	$27,305,567
Imports:					
Kaolin or china clay..........short tons..	339,014	140,888	122,232	105,567	[2] 66,945
Common blue and Gross-Almerode short tons..	12,130	11,306	27,108	32,141	[2] 20,872
Fuller's earth..........do....	8,118	4,708	2,256	474	[2] 241
Other clay..........do....	61,048	24,713	16,922	2,267	[2] 150
Total imports:					
Quantity..........do....	420,310	181,615	168,518	140,449	[2] 88,208
Value..........	$3,841,462	$1,595,101	$1,608,395	$1,159,790	[2] $890,263
Exports:					
Fire clay..........short tons..	55,316	39,709	61,247	96,501	[2] 66,080
Other clay (including fuller's earth) short tons..	54,028	68,978	87,824	87,667	[2] 81,452
Total exports:					
Quantity..........do....	109,344	108,687	149,071	184,168	[2] 147,532
Value..........	$1,217,769	$1,323,744	$1,819,242	$2,071,336	[2] $1,647,435

[1] Sales of bentonite included under "Miscellaneous clay" before 1930.
[2] Figures cover January to September, inclusive.

However, virtually all the kaolin, ball clay, and bentonite, plus a large and increasing percentage of the fire clay output, is marketed or used elsewhere by the producers. These clays are worth many times as much per ton as those used generally for heavy clay products; therefore, the total value of a merchant clay probably is higher than the book value of the clay used in integrated plants. Whereas the tonnage and value of china clay sold and used elsewhere for paper or pottery is reported by the Bureau of Mines as raw clay and credited as a product of the State in which it was mined, clay converted into common brick or sewer pipe is not reported as raw clay because doing so would result in duplication; it is included in the value of clay products as reported by the Bureau of the Census and included by

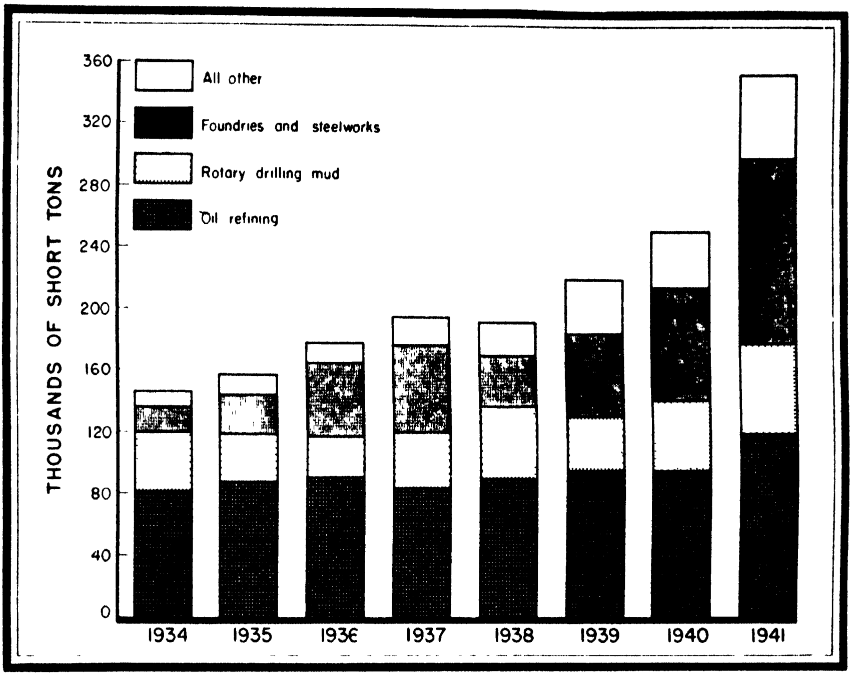

FIGURE 1.—Bentonite sold by domestic producers for specified uses, 1934-41.

the Bureau of Mines in its summarized mineral production statistics for the various States.

CONSUMPTION AND USES

The following table gives sales of specified domestic clays by kinds and uses in 1941, continuing the series begun in 1921. Data for total clay used in 1939 and earlier years by major uses (except refractories) were summarized in a bar chart in Minerals Yearbook, 1940 (p. 1268); and in the corresponding chapter of Minerals Yearbook, Review of 1940 (p. 1227), changes in distribution of sales of kaolin, by uses, were plotted. In the present chapter, figure 1 shows changes in distribution of sales of bentonite, by uses.

Clay (including fuller's earth) sold or used by producers in the United States in 1941, by kinds and uses, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay, including slip clay	Fuller's earth	Total
Pottery and stoneware:							
Whiteware, etc	102,346	148,600	15,886		509		267,341
Stoneware, including chemical stoneware		609	42,605				43,214
Art pottery, flowerpots, etc.	103	544	8,701		7,083		16,431
Slip for glazing		500			762		1,262
	102,449	150,253	67,192		8,354		328,248
Tile, high-grade	23,132	32,048	7,782		1,395		64,357
Kiln furniture, etc.:							
Saggers, pins, stilts	3,345	953	48,839				53,137
Wads			8,533				8,533
	3,345	953	57,372				61,670
Architectural terra cotta		217	21,021				21,238
Paper:							
Filler	431,493	2,000	743				434,236
Coating	173,572						173,572
	605,065	2,000	743				607,808
Rubber	127,055		9,000				136,055
Linoleum and oilcloth	9,813	8,792	14,315				32,920
Paints:							
Filler or extender	12,793		4				12,797
Calcimine	1,660		5,496			7	7,163
	14,453		5,500			7	19,960
Cement manufacture	42,761		18,665	1,935	298,014		361,375
Refractories:							
Fire brick and block	115,781	491	2,450,101				2,566,373
Bauxite, high-alumina brick			105,077				105,077
Fire-clay mortar, including clay processed for laying fire brick	1,283		284,255		693		286,231
Clay crucibles	787	169	3,770				4,726
Glass refractories	1,553	184	43,541				45,278
Zinc retorts and condensers			40,966				40,966
Foundries and steel works	4,048		762,990	121,283	48,023	252	936,596
	123,452	844	3,690,700	121,283	48,716	252	3,985,247
Miscellaneous							
Rotary-drilling mud			348	58,468	175,539	3,769	238,124
Filtering and decolorizing oils (raw and activated earths)				118,625		[1] 198,991	317,616
Other filtering and clarifying	130			1,969		3,231	5,330
Artificial abrasives	275	41	2,282		3,766		6,364
Asbestos products	1,440	250	777				2,467
Chemicals	3,526		13,478				17,004
Enameling	51	2,724	20,071		725		23,571
Filler (other than paper or paint)	1,235			6,925	18,041	278	26,479
Plaster and plaster products	8,306		100				8,406
Concrete admixture, sealing dams, etc.				2,519			2,519
Heavy clay products			230,467		642,704		873,171
Other uses	21,360	323	7,754	42,304	12,914	918	85,573
	36,323	3,338	275,277	230,810	853,680	207,187	1,606,624
Grand total							
1941	1,087,848	198,445	4,167,567	354,028	1,210,168	207,446	7,225,502
1940	833,450	140,707	2,765,247	251,032	710,515	146,568	4,847,510

[1] Comprises the following: Mineral oils, 177,151 short tons; vegetable oils, 21,840 short tons.

CHINA CLAY OR KAOLIN

Sales of domestic kaolin or china clay jumped to 1,087,848 short tons valued at $9,205,892 in 1941 from 833,450 tons valued at $6,994,106 in 1940. The tonnage topped that of the all-time record for the previous year by 31 percent and was more than double that of 1929. The paper industry alone required 110,000 tons more than in 1940 and consumed 56 percent of the total shipments. Percentage-wise, however, the consumption of clay for refractories, pottery, rubber, paint, and certain minor uses increased even more than shipments of paper clay.

Imports for the first 9 months of 1941—almost all English clay, which is used chiefly in paper, sanitary ware, and pottery and to a diminishing extent in porcelain and tile—amounted to only 66,945 short tons, with a foreign market value of $698,502. Import statistics for the last quarter cannot be published, but the 1941 total was undoubtedly less than the 105,567 tons imported in 1940. Average figures for 1925–29 show imports of 339,014 tons and domestic shipments of only 453,618 tons a year, and for 1909–13 the ratio of imports to domestic shipments was nearly 2 : 1 (261,266 and 132,114 tons a year, respectively).

Georgia was the leading kaolin-mining State in 1941, as usual, producing 787,013 tons or 72 percent of the national output; South Carolina (with 177,276 tons or 16 percent of the total) ranked second, and Pennsylvania (with 44,277 tons or 4 percent) third. In order of output, the other producing States were Florida, California, North Carolina, Virginia, Delaware, Illinois, Alabama, Maryland, Vermont, Utah, and Tennessee.

The location of kaolin mines in the United States is shown in figure 2.

Nine firms, operating 14 mines and each producing 30,000 tons or more, supplied 80 percent of the quantity and 84 percent of the value of the total sales in 1941; in 1940 approximately the same percentages of the quantity and value of the total shipments (which were smaller) came from 10 firms operating 15 mines. More than half of the firms reporting output in 1941 produced less than 4,000 tons each, and their aggregate contribution represented only 3 percent of the total tonnage shipped. The total output of the 42 smallest firms was less than that of any of the three largest firms in 1941.

Price quotations for domestic clays have remained virtually unchanged for several years, and readjustments of English clay prices have largely followed changes in ocean freight and insurance. Availability of bottoms was indicated by a reduction of $1 a long ton in the freight rate in the summer of 1941. The gradual increase in average value of domestic sales—from $7.94 in 1939 to $8.28 in 1940 and $8.46 in 1941—shows that the proportion of higher-grade clays is now greater rather than that prices have experienced a general rise.

More than 50 geographically separate kaolin deposits associated with the Spruce Pine alaskite have been found in Avery, Mitchell, and Yancey Counties, N. C., where total reserves of crude kaolin have been estimated at 51,000,000 tons, of which perhaps 10 percent is recoverable as refined china clay. The Tennessee Valley Authority and the Bureau of Mines, in collaboration with local producers, have

tested thoroughly the application of North Carolina kaolins, feldspar, and other materials in the manufacture of all-American dinner-ware and sanitary-ware bodies. The State geologist [2] published a brief report on the possibilities of producing high-grade ceramic products in western North Carolina.

Kaolin sold or used by producers in the United States, 1939–41, by States

State	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	(1)	(1)	(1)	(1)
California	10, 481	$111, 719	14, 407	$118, 481	20, 810	$164, 110
Delaware	(1)	(1)	(1)	(1)	(1)	(1)
Florida	(1)	(1)	(1)	(1)	(1)	(1)
Georgia	512, 214	4, 135, 727	570, 010	4, 834, 826	787, 013	6, 573, 605
Illinois	-----	-----	-----	-----	(1)	(1)
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	11, 308	165, 896	14, 602	202, 642	(1)	(1)
Pennsylvania	49, 657	164, 562	49, 541	169, 981	44, 277	172, 783
South Carolina	158, 629	1, 297, 813	152, 227	1, 302, 812	177, 276	1, 596, 471
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Vermont	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Washington	(1)	(1)	-----	-----	-----	-----
Undistributed [2]	29, 515	324, 889	32, 663	365, 364	58, 472	698, 923
	780, 804	6, 200, 606	833, 450	6, 994, 106	1, 087, 848	9, 205, 892

[1] Included under "Undistributed." [2] Includes States indicated by "(1)" above.

Georgia kaolin sold or used by producers, 1937–41, by uses

Year	China clay, paper clay, etc.			Refractory uses			Total kaolin		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
1937	423, 065	$3, 332, 851	$7.88	80, 667	$213, 208	$2.64	503, 732	$3, 546, 059	$7.04
1938	367, 612	3, 199, 169	8.70	45, 020	115, 749	2.57	412, 632	3, 314, 918	8.03
1939	450, 121	3, 956, 344	8.79	62, 093	179, 383	2.89	512, 214	4, 135, 727	8.07
1940	497, 881	4, 625, 080	9.29	72, 129	209, 746	2.91	570, 010	4, 834, 826	8.48
1941	669, 978	6, 216, 087	9.28	117, 035	357, 518	3.05	787, 013	6, 573, 605	8.35

For 1939 the Bureau of the Census reports (Preliminary Report, December 1941) the domestic production of kaolin as 751,000 short tons, or slightly less than the Bureau of Mines shipment figure of 780,000 tons which includes the output of operations too small for the Census to canvass as well as any quantities that were shipped from stock mined in earlier years. Including kaolin, ball clay, and certain miscellaneous clays (used principally for oil-well drilling muds), the Census reports a total production in 1939 of 1,050,000 tons of clay by the "Kaolin and ball-clay" industry, which comprised 95 pits or mines and 53 associated preparation plants in 19 States. Most of this was mined from open pits, although there were 5 small underground or combination underground and open-pit operations, 1 hydraulicking, and 1 dredge operation. The value of all products was $7,239,000.

[2] North Carolina Department of Conservation and Development, Division of Mineral Resources, Manufacturing China Clay Opportunities in North Carolina: Bull. 40, 1941, 24 pp

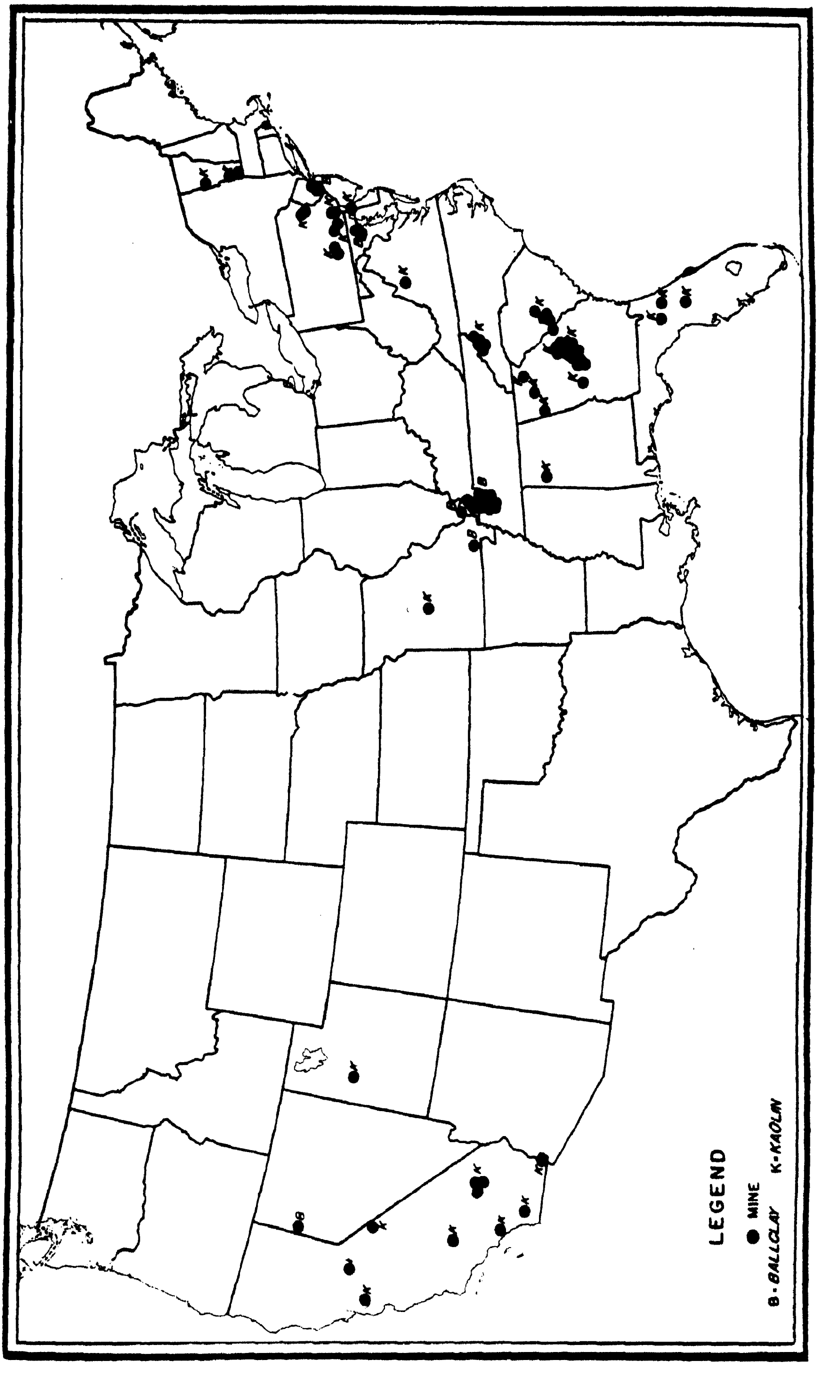

FIGURE 2.—Location of kaolin and ball-clay mines in the United States.

Wages were $1,830,000, and salaries (266 employees) were $637,000. Expenditures for supplies and materials ($896,000), fuel ($530,000), purchased electric energy (19,596 kw.-hr., $241,000), and contract work ($135,000) raised the reported expenses to an aggregate of $4,269,000. Buildings, machinery, and equipment erected or installed during 1939 cost $1,220,000. About 60 percent of the average of 3,168 wage earners were employed at operations in Georgia. Of the total number of man-hours worked by wage earners (5,987,000 or 7.3 hours per man per shift), about 40 percent was chargeable to mining and 60 percent to preparation. Average wage payments per hour ranged from 27 to 39 cents in Southeastern States and from 56 to 62 in Rocky Mountain and Pacific Coast States; the national average was 31 cents.

BALL CLAY

Reflecting increased activity by American potters and further displacement of imported clays, shipments of ball clay from domestic mines climbed to 198,445 short tons valued at $1,677,600 in 1941, or 41 percent in quantity and 57 percent in value over the former record of 140,077 tons and $1,065,432 in 1940, and continued a long ascent that has been interrupted seriously only once since 1932.

As in former years, most of the output in 1941 came from the Kentucky-Tennessee field. These two States furnished 94 percent of the total tonnage; the remainder was mined mostly in Maryland and New Jersey, although Mississippi, Missouri, and Nevada reported small shipments.

The location of ball-clay mines in the United States is shown in figure 2.

The sharp advance in unit values was notable; the national average sales realization rose to $8.45 a ton from $7.57 in 1940 and $7.28 in 1939. For Kentucky alone, the average sales price was $8.95, 13 percent higher than the 1940 average and the highest in any year since 1931. These increases, however, were not due entirely to a mark-up in quotations but also represent steady improvement in quality and the fact that much of the clay, instead of being shipped crude, is now being shredded or even pulverized by producers before shipment to consumers.

One company, with clay pits in both Kentucky and Tennessee, has long been the largest single producer; in 1941, although 17 companies reported shipments of ball clay, 86 percent of the total tonnage was furnished by 5 companies.

Imports of English ball clay in 1941, as indicated by statistics that cover only the first 9 months of the year, were substantially less than the 1940 imports which amounted in the full year to 32,141 short tons having a foreign market value of approximately $8 a ton, exclusive of freight, duty, and other charges. About half of the imported ball clay is used in sanitary ware. Formerly, it was demanded by virtually all manufacturers of electrical porcelain, vitrified china, and other high-grade products, but as domestic ball clays have been standardized and better-prepared they have been widely accepted by potters and ceramic engineers. Meanwhile, as noted in last year's chapter of this series, the ratio of ball clay to kaolin has tended to increase as a result of growing mechanization of the ceramic industry and new casting methods.

True ball clays are fine-grained, sedimentary clays that are characteristically plastic and develop high strength, usually accompanied by rather high shrinkage, in drying and firing. They vitrify at low temperatures, having a long firing range, and may range in P.C.E. values from cone 18 to cone 34. The borderline between ball clays and certain other clays, especially plastic fire clay, is not always sharply drawn, but all the better ball clays burn to a cream white or a sufficiently light buff so that they can be used in whiteware bodies.

Ball clay sold by producers in the United States, 1939–41, by States

State	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Kentucky	66,461	$507,938	75,933	$600,264	105,586	$944,705
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Mississippi					(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
Nevada			(1)	(1)	(1)	(1)
New Jersey	3,245	21,651	(1)	(1)	(1)	(1)
Tennessee	47,971	365,810	53,871	414,602	80,506	664,906
Undistributed [2]	10,924	40,322	10,903	50,566	12,353	67,989
	128,601	935,721	140,707	1,065,432	198,445	1,677,600

[1] Included under "Undistributed." [2] Includes States indicated by "(1)."

FIRE CLAY

Jumping far ahead of the rising index of steel production and other barometers of consumption, shipments of fire clay (including a small quantity of so-called "stoneware" clay) rose 51 percent in 1941 to 4,167,567 short tons worth $10,455,909 from 2,765,247 tons and $7,046,746 in 1940 and the previous all-time record of 3,266,261 tons and $8,289,487 in 1929. These figures relate only to clay sold or shipped raw and do not include that burned into fire brick or clay products in integrated plants at the mine or pit, amounting to an additional 3,275,021 tons in 1941 and 2,039,377 tons in 1940.

Producers in 32 States shipped fire clay and stoneware clay in 1941, but as in former years more than one-fourth of the total was mined in Pennsylvania, and this State, together with Ohio and Missouri, furnished 63 percent of all the fire clay and stoneware clay sold or shipped raw and almost 70 percent of that made directly into fire brick or other products at the mines. Figure 3 shows the location of mines producing fire clay and stoneware clay in the United States.

As in other branches of the refractory industry, a few large companies are the principal miners of fire clay, each company owning and operating properties in various States and producing clay for use largely in its own plants. In addition, however, a score of other large or medium-size concerns are more or less completely self-contained and are important factors in their respective local markets. Of the total shipments in 1941, the 5 largest concerns furnished 36 percent; the next 5, 11 percent; and the next 15, 15 percent. Ranked in order of total clay, whether used at the pits or shipped, the 5 largest concerns represented 29 percent of the total tonnage; the next 5, 10 percent; and the next 15, 14 percent. Producers, including a great many small operators, totaled 499. Inspection of the returns indi-

cates a relatively large number of mining units producing 10,000 to 50,000 tons a year—implying that this may be an economical size of operation.

The main use of fire clay, of course, is in refractories. In 1941 demands were boosted not only by the record rate of operations at steel and nonferrous metal plants but also by the large amount of new construction. Great quantities of fire brick, for example, were needed for lining new blast furnaces and relining old ones and for all of their accessory equipment, including stoves for heating the blast, boiler plants, and coke ovens. The consumption of brick for rebuilding beehive coke ovens was exceptionally large. Under normal conditions byproduct ovens are more economical than beehive, but they take

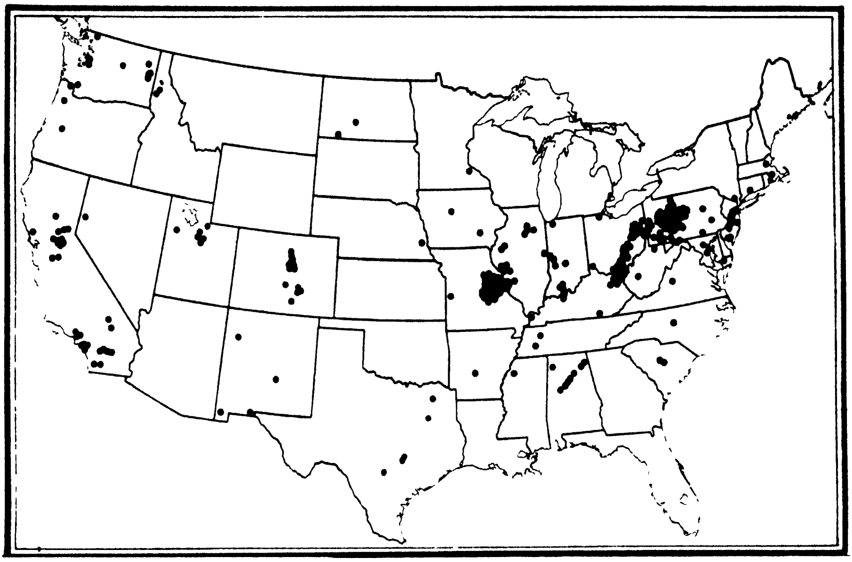

FIGURE 3.—Location of fire-clay mines in the United States.

longer to build. Many new furnaces had to be built for making shells, heat treating, annealing, or normalizing.

The Bureau of the Census reports (Preliminary Report, November 1941) a total of 4,074,000 tons of fire clay and 27,000 tons of stoneware clay produced in 1939 from 306 operations in 19 States. Pennsylvania was the largest producing State, contributing 25 percent of the total, Ohio was a close second with 23 percent, and Missouri ranked third with 17 percent. Underground mines supplied almost half of the total output, and operations combining open-pit and underground methods recovered about 10 percent; 42 percent was produced from open pits. In Pennsylvania 10 percent was produced from open pits. For the country as a whole, the output was 0.95 ton per man-hour for open pits and 0.63 for underground mines, but in Pennsylvania the ratio was 0.66 : 0.63. Wages ($3,365,838) of 3,655 wage earners and salaries ($498,506) of 255 other employees represented over 53 percent of the total value of products.

The Bureau of Mines figures for fire clay show a total of only 2,222,295 tons in 1939, but these data comprise only clay that was

sold or shipped away from pits. Including the 1,984,709 tons reported as burned into clay products at the mine, the Bureau of Mines canvass showed 4,207,004 tons or slightly more than the quantity reported by the Census which does not cover small operations whose sales or expenditures were less than $2,500 during the year.

Fire clay, including stoneware clay, sold or used by producers in the United States, 1939–41, by States

State	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	27, 715	$51, 133	42, 843	$74, 868	52, 509	$108, 703
California	162, 244	389, 448	193, 713	459, 680	316, 226	714, 779
Colorado	52, 310	72, 644	52, 695	89, 206	84, 986	143, 398
Illinois	124, 778	267, 254	147, 148	308, 711	201, 139	448, 002
Indiana	40, 393	67, 669	69, 144	82, 962	111, 551	142, 329
Kentucky	181, 286	495, 818	269, 090	728, 380	395, 524	1, 288, 666
Maryland	24, 091	83, 541	12, 582	67, 479	17, 790	99, 229
Missouri [1]	384, 567	1, 171, 643	487, 650	1, 391, 045	794, 705	1, 782, 139
New Jersey	92, 884	499, 720	91, 325	512, 546	133, 126	714, 925
New Mexico	(2)	(2)	3, 263	10, 928	(2)	(2)
Ohio	445, 610	898, 429	470, 101	1, 039, 228	689, 187	1, 689, 308
Pennsylvania	572, 191	1, 478, 729	794, 702	1, 984, 272	1, 130, 525	2, 848, 040
South Carolina	(2)	(2)	(2)	(2)	4, 046	7, 576
Tennessee	13, 836	58, 943	(2)	(2)	38, 120	117, 168
Texas	5, 837	34, 196	12, 498	22, 686	31, 646	45, 880
Utah	20, 441	42, 137	20, 113	40, 107	15, 473	31, 150
Washington	20, 356	47, 734	21, 108	36, 097	65, 521	91, 604
West Virginia	46, 758	93, 426	55, 853	103, 989	70, 885	133, 300
Other States [3]	6, 998	49, 529	21, 419	94, 562	14, 608	49, 704
	2, 222, 295	5, 801, 993	2, 765, 247	7, 046, 746	4, 167, 567	10, 455, 909

[1] Includes diaspore and burley clay as follows—1939: 40,495 short tons, valued at $174,144; 1940: 34,359 tons, $156,603; 1941: 79,897 tons, $405,673.
[2] Included under "Other States."
[3] Includes States indicated by "(2)" above, and Arkansas, Connecticut (1939–40), Idaho, Iowa, Massachusetts, Minnesota, Mississippi (1941), Nebraska, Nevada (1940–41), North Carolina, North Dakota, Oregon, Vermont (1941), and Virginia.

BENTONITE

Forty-one percent more bentonite was mined in the United States and sold during 1941 than during 1940, the former all-time record year for this remarkable clay, whose properties have only recently been put to extensive use. The output jumped to 354,028 short tons from 251,032 tons in 1940 and 219,720 tons in 1939; as recently as 1925, the total output was less than 5,000 tons. The value of the 1941 shipments increased to $2,451,900 from $1,919,461 and $1,702,393 in 1940 and 1939, respectively.

Owing to the speed-up in munitions plants, the main increase in consumption was in foundry and core sands; 121,283 tons (34 percent) of the total in 1941 were used for this purpose as against 74,135 tons (only 30 percent) of the total in 1940. Substantial increases were noted in virtually all uses, of which oil-refining (118,625 tons) and oil-well drilling muds (58,468 tons) ranked next to foundry work in quantities consumed.

Fully 60 percent of the 1941 tonnage was Type 1 swelling or Black Hills-type bentonite, which is mined principally in eastern Wyoming, western South Dakota, and California. Much of the remainder was of the nonswelling, nonsuspendible type (sub-bentonite), employed largely for oil refining after activation with acid and to a minor extent for foundry and other uses.

Figure 4 shows the location of bentonite mines in the United States. On the borderline between Type 2 bentonite and fuller's earth are various clays found in Texas and Utah, some of which are acid-sprayed or otherwise treated to enhance their natural bleaching or filtering properties when used in oil refining. Certain producers who formerly classified such clays as bentonite or miscellaneous clays now describe them as "fuller's earth."

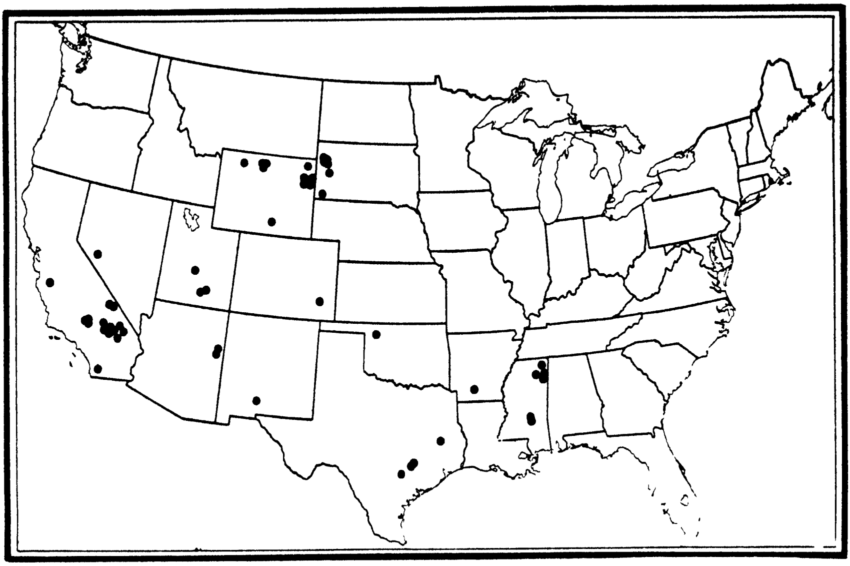

FIGURE 4.—Location of bentonite mines in the United States.

Bentonite sold or used by producers in the United States, 1938–41, by States

State	1938		1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)				
Arizona	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
California	15,703	$166,998	11,699	$143,314	7,867	$99,840	6,981	$69,776
Colorado					(1)	(1)		
Mississippi	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Nevada					(1)	(1)		
New Mexico	(1)	(1)	(1)	(1)				
Oklahoma	(1)	(1)	(1)	(1)	(1)	(1)		
South Dakota	20,565	155,821	31,528	217,622	40,481	274,714	57,139	401,758
Texas	21,744	207,084	18,132	148,139	14,399	127,949	11,593	105,312
Utah	(1)	(1)	(1)	(1)	(1)	(1)		
Wyoming	58,911	530,834	76,133	777,722	91,714	976,844	145,574	1,369,057
Undistributed [2]	75,260	312,445	82,228	415,596	96,571	440,114	132,741	505,997
	192,183	1,373,182	219,720	1,702,393	251,032	1,919,461	354,028	2,451,900

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

The Nation-wide average price of $6.93 a ton f. o. b. mines in 1941 was much lower than the average of $7.65 in 1940; for Wyoming alone the average declined to $9.39 from $10.65 in 1940 and $10.22 in 1939. Trade-journal quotations, however, have remained for years at $8 a

ton for dried and crushed material in bulk and $10 in bags f. o. b. Wyoming mines, carlots. Actual prices likewise have continued unchanged at around $10.25 a ton for the widely used 200-mesh powder (f. o. b. Black Hills shipping point in 100-pound bags) and $7 a ton for 4- to 20-mesh material in bulk or $8.75 in bags. Bags are an important cost item but are not included in Bureau of Mines valuations. A steady decline in average unit values in recent years is due to larger quantities sold in carlots rather than less-than-carlots and possibly to a relative decline in the proportion of powdered clay. Sales of high-price, processed clay for specialized uses have increased but not enough to offset the effect of heavier sales of bulk products.

FULLER'S EARTH

Shipments of fuller's earth or natural bleaching clay increased in 1941 to 207,446 short tons valued at $2,111,674 from only 146,568 tons and $1,471,083 in 1940, or 42 percent in tonnage. Petroleum refining, which consumed 85 percent of the total in 1941 and 90 percent in 1940, increased only 9 percent. The quantity (21,840 tons) used for bleaching vegetable oils and animal fats nearly doubled, and the quantity (8,455 tons) used for other purposes more than doubled in 1941; but the apparent increase from 132,259 to 177,151 tons used in mineral-oil refining was due mainly to reclassification of their material by several producers.

The distinction between fuller's earth and other clays used in oil refining is largely a matter of opinion, as virtually all clays have some natural bleaching power and it is difficult to classify clays whose bleaching properties have been enhanced by acid-spraying or other treatment. Certain types of bentonite having little or no natural bleaching power are not fuller's earth, even though they are highly activated by acid treatment. In former years, 20,000 to 40,000 tons of borderline material produced principally in Texas has been classed as "miscellaneous clay" or "sub-bentonite", but in 1941 the trend was to emphasize its natural bleaching powers and so to call it "fuller's earth." For this reason, the 1941 statistics should not be interpreted as indicating a definite reversal of the downward trend owing to the substitution of other bleaching or clarifying agents and the adoption of oil-refining methods that reduce the requirements of natural bleaching clays. On the other hand, they may indicate that this trend is retarded or perhaps even has run its course.

The competition of acid-treated bentonite, activated bauxite, synthetic magnesium silicate, and other processed bleaching materials has intensified the importance of transportation cost, which often exceeds the total production cost of fuller's earth. Although clays having high bleaching power in their natural state are not widely distributed, location is a leading factor in successful operation of fuller's earth deposits. Florida and Georgia usually have furnished more than half of the total domestic output, although Texas, Illinois, or Nevada occasionally has outranked one or the other of these older sources as regards tonnage produced in a given year. In 1941, due in part to the inclusion of acid-sprayed earths and other borderline material, Texas was the leading producing State. The average value of the Texas clay, however, was only $9.26 a ton, f. o. b. mines, compared with $11.70 for the combined output of Florida and Georgia.

Notwithstanding definite improvement in quality and preparation of the fuller's earth marketed, the average value of the entire domestic output has ranged only slightly above $10 in recent years following an almost steady decline from $19.51 in 1920 to $13.64 in 1929 and a low point of $9.28 in 1933.

Fuller's earth sold or used by producers in the United States, 1939–41, by States

State	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	91,947	$1,035,066	79,898	$917,365	91,925	$1,075,318
Illinois	(1)	(1)	(1)	(1)	26,676	209,577
Texas	38,338	359,058	34,039	277,229	77,033	713,085
Other States [2]	36,785	297,731	32,631	276,489	11,812	113,694
	167,070	1,691,855	146,568	1,471,083	207,446	2,111,674

[1] Included under "Other States."
[2] 1939: California, Colorado, Illinois, Nevada, and Tennessee; 1940: Colorado, Illinois, Nevada, New Mexico, and Tennessee; 1941: California, Nevada, New Mexico, Tennessee, and Utah.

MISCELLANEOUS CLAY

As previously noted, Bureau of Mines data on shipments of "miscellaneous clay" do not include clay burned into clay products at the mines; in fact, the above classification is largely a "catch-all" designed to cover merchant clays not elsewhere listed in this chapter. The foregoing table of consumption by uses shows that most of the tonnage in this category is consumed in the manufacture of heavy clay products, followed by cement manufacture. The next largest item is rotary-drilling muds (in which it may be blended with bentonite), and substantial quantities are used in foundries and steel works. Very small quantities of slip clay are also included. The total shipments of miscellaneous clay in 1941 were 1,210,168 tons valued at $1,402,592, 70 percent more in quantity than in 1940. In addition, mine operators reported the consumption of 7,261,513 tons of clay burned into clay products at the mines. The summation of these figures (8,471,681 tons in 1941), however, does not cover the entire common-clay and shale industry of the United States, which, according to the Bureau of the Census (Preliminary Report, December 1941), produced 16,062,000 short tons of clay in 1939; the 1941 total output was doubtless larger than that in the census year 1939. The Census Bureau figures include 1,088,000 tons of clay used in the manufacture of cement but exclude 1,235,000 tons of clay and shale from pits worked in conjunction with limestone quarries and consequently considered by the Census as products of the limestone industry.

Additional information abstracted from the Census report follows:

The bulk of the tonnage was used in the manufacture of heavy clay products such as brick, hollow structural tile, architectural terra cotta, roofing tile, and sewer pipe. Open pits furnished 93 percent of the tonnage, underground mines 5 percent, and combination open-pit and underground operations, the remainder. Although common clay and shale are produced in 45 of the 48 States and in the District of Columbia about half the total quantity was mined in Ohio, New York, Pennsylvania, Illinois, Texas, North Carolina, and Georgia. Operations in Ohio employed 595 wage earners; those in Pennsylvania, 255; and those in Illinois, 172. Total monthly employment ranged from a low of 2,247 in February to a peak of 3,266 in June. The number of days operated ranged from only 74 in Oregon to

260 in South Carolina, and the tons of clay produced per man-hour averaged 2.93 to 3.36 for open pits and 1.04 for underground mines. In Ohio the output per wage-earner hour averaged 2.07; in New York, 5.92; in Pennsylvania, 2.66; and in Illinois, 3.35. The average hourly earnings of wage earners was 51 cents, ranging from 30 cents in the Southeastern States to about 65 cents in the Northeastern States.

The industry paid $2,793,000 in wages to an average of 2,906 wage earners during the year. Salaried employees, numbering 61 in October, were paid $94,000. Expenditures for supplies and materials amounted to $629,000; for fuel, $384,000; and for purchased electric energy, $214,000. In addition, $99,000 was paid for work done on contract. These reported expenses totaled $4,213,000. The cost of buildings erected and machinery and equipment installed in 1939 was $258,000.

Miscellaneous clay, including slip clay [1] and shale, sold or used by producers in the United States, 1938–41, by States

State	1938		1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(2)	(2)	(2)	(2)	100,522	$60,583	125,563	$70,273
Arkansas	(2)	(2)	(2)	(2)	24,421	10,533	(2)	(2)
California	135,923	$374,166	117,286	$250,328	127,539	248,632	186,123	473,846
Colorado	54,115	49,249	76,081	78,159	62,803	64,842	79,458	83,246
Illinois	(2)	(2)	(2)	(2)	(2)	(2)	73,468	66,408
Indiana	3,089	1,692	17,402	12,024	20,086	9,750	106,362	34,038
Iowa	6,055	36,725	4,655	40,081	9,548	47,566	9,690	46,759
Louisiana	(2)	(2)	(2)	(2)	10,189	96,314	(2)	(2)
Nebraska	16,009	7,532	19,567	8,910	10,406	5,516	11,949	5,748
Ohio	47,226	28,751	23,542	14,351	44,156	18,788	52,468	21,760
Pennsylvania	39,196	23,136	45,292	31,728	54,930	35,256	59,565	24,856
Texas	(2)	(2)	(2)	(2)	65,822	257,238	94,698	180,681
Washington	11,901	10,638	8,272	5,744	14,807	11,256	(2)	(2)
Other States [3]	76,201	329,770	97,177	272,880	165,286	270,466	410,824	394,977
	389,715	861,659	409,274	714,205	710,515	1,136,740	1,210,168	1,402,592

[1] Includes slip clay as follows. From Michigan and New York in 1938, 2,227 tons, valued at $13,955, and in 1939, 2,564 tons, $17,654; from Michigan, New York, and Ohio in 1940, 4,365 tons, $29,268; and from Kentucky, Michigan, New York, Ohio, and Pennsylvania in 1941, 5,649 tons, $40,797.

[2] Included under "Other States."

[3] Includes States indicated by "(2)" above, and Connecticut, Georgia, Kansas (1939–41), Kentucky (1939 and 1941), Maine (1939), Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri (1940–41), Montana, Nevada (1939–41), New Jersey, New Mexico, New York, Oklahoma, Oregon (1941), Tennessee (1940–41), Utah, and Wisconsin (1941).

CLAY PRODUCTS

The total output of the clay-products industries has varied greatly, but in recent years its value has averaged close to $250,000,000 annually, about half being structural products. Figure 5, furnished through courtesy of the National Clay Products Institute, Washington, D. C., shows the geographic distribution of clay-products plants in the United States.

A comprehensive report on the floor- and wall-tile industries was issued in 1941.[3]

The industries producing common brick and other heavy clay products were more active in 1941 than for many years previously, but their output still was not more than half that in the record year 1926. Further recovery is indicated. Masonry requires less metal than any other form of construction; and, particularly where permanence is desired, clay products are favorably considered. Adequate numbers of bricklayers and masons were available in 1941. Increased interest was shown in the larger building units, including tile up to

[3] U. S. Tariff Commission, Earthen Floor and Wall Tile: Rept 141, 2d Ser., 1941, 158 pp.

10 by 12 by 12 inches. In England, hollow tile filled with sand was an effective protection for store fronts and dwellings during aerial attack, and in the United States an air-raid shelter using steel-reinforced light tile has been designed. Loose piles of brick afforded excellent protection from bombs and have been recommended in some cases instead of sand bags owing to the shortage of burlap and the possible rotting of the fabric. Clay slabs laid over the attics or upper floors of residences are mentioned by the National Bureau of Standards as a protective measure against incendiary bombs.

The Wage and Hour Division of the United States Department of Labor issued a wage order effective September 1, 1941, establishing a minimum wage of 34 cents an hour for workers in brick factories, instead of the 30-cent hourly wage formerly in effect; approximately

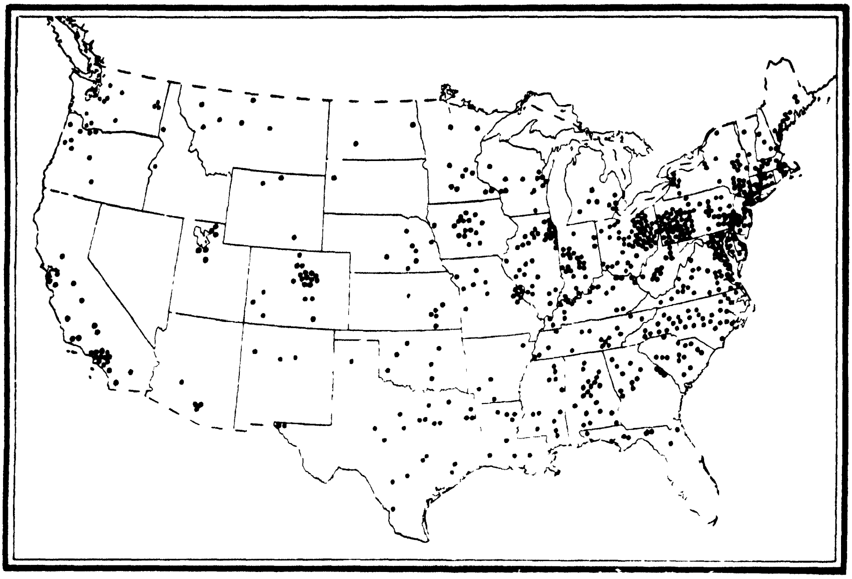

Figure 5.—Location of structural clay-products plants in the United States.

3,900 wage earners in 14 Southern States were benefited. Virtually all workers in the industry elsewhere in the Nation already received at least 40 cents an hour.

TECHNOLOGIC DEVELOPMENTS

Stepping up aluminum production to meet the ever-expanding needs of war-plant construction prompted reappraisal of clay as a possible source of the metal. Pure kaolin contains almost 40 percent alumina or roughly two-thirds as much as does bauxite, which hitherto has been considered the only economic ore of aluminum. Much of our bauxite comes from Surinam and after leaving the ship may be hauled hundreds of miles by rail to a chemical plant; the purified alumina then may go 2,000 miles farther to reach cheap electric power. Including mining, transportation, and treatment charges, purified alumina therefore costs $45 to $55 a short ton delivered at reduction plants in North America. As large clay deposits containing 30 per-

cent or more alumina occur within a radius of 100 miles of most of these reduction works or power sites, the incentive to use clay instead of bauxite is sufficient on financial grounds alone, wholly apart from the wartime problems of bringing sea-borne cargoes to American ports.

In 1940, the Tennessee Valley Authority announced that it had developed a process for making aluminum from clay, and it is said to have operated a pilot plant successfully for over a year, although no technical details have been released. Prof. Arthur Hixson, of Columbia University, recently described [4] a process for digesting selected high-silica clay with hydrochloric acid and decomposing the resultant product to get hydrochloric acid (which is returned to the process), and alumina (which can be reduced to metal in the conventional way).

[4] Hixson, Arthur W., Oil, Paint and Drug Reporter, vol. 140, No. 19, November 10, 1941, p. 81.

ABRASIVE MATERIALS

By Robert W. Metcalf

SUMMARY OUTLINE

GENERAL CONDITIONS

The total value of products of the natural abrasives industries in 1941 was about 50 percent greater than in 1940. All types of abrasive materials except pulpstones and "oilstones and related products" made large gains over 1940 in value of sales. The value of pumice and pumicite sales established a new record, sales of ground sand and sandstone were the highest known except in 1917, and sales of emery were the highest since 1918. Garnet sales, except for 1937, had their greatest value since 1929.

Salient statistics of the abrasives industries in the United States, 1940–41

	1940	1941	Percent of increase, 1941 over 1940
Domestic production (sold or used by producers):			
Natural silica abrasives:			
Diatomite	(1)	(1)	
Tripoli	$366,569	$421,746	15
Quartz	176,390	228,587	30
Ground sand and sandstone	2,088,314	3,073,730	47
Special silica-stone products			
Grindstones and pulpstones	496,448	545,556	10
Oilstones and related products	(1)	(1)	
Millstones	6,558	15,579	138
Flint lining and grinding pebbles	(1)	276,042	
Natural silicate abrasives:			
Pumice and pumicite	449,914	669,514	49
Garnet	259,345	371,752	43
Natural alumina abrasives:			
Emery	9,349	42,484	354
Total natural abrasives [2]	[2] 3,852,887	[2] 5,644,990	
Total artificial abrasives [3]	10,142,691	16,444,319	62
Foreign trade:			
Imports	11,517,117	[4] 7,732,963	
Exports	1,605,961	[4] 1,884,938	

[1] Bureau of Mines not at liberty to publish figures. Average for diatomite for 1939–41 was $1,915,405.
[2] Excludes in 1940 value of diatomite, flint lining and grinding pebbles, and oilstones and related products and in 1941 value of diatomite and oilstones and related products, which the Bureau of Mines is not at liberty to publish.
[3] Includes some material produced in Canada; Bureau of Mines not at liberty to publish United States data separately.
[4] Figures cover January to September, inclusive.

Output of crude manufactured (artificial) abrasives broke all records for the second successive year, rising in 1941 to 279,030 short tons—54 percent above the former record year 1940; the total value also established an all-time high—$16,444,319, or 52 percent above the previous high value in 1929. All three types of manufactured abrasives for which figures are shown surpassed by large margins the former records achieved in 1940. The percentages of increase in 1941 compared with 1940 were: Silicon carbide, 36 percent; aluminum oxide, 50 percent; and metallic abrasives, 73 percent. In the period of 1941 (January–September), for which foreign trade data may be published, imports of diamond dust and smaller industrial diamonds continued unabated, receipts of corundum ore were larger than in any full year since 1936, emery ore receipts ceased entirely, and crude pumice receipts were virtually nonexistent. Total exports of natural abrasive materials in this period were greater than in the full year 1940, in spite of a large decrease in exports of grindstones and of emery and corundum abrasive wheels.

This chapter includes data for most of the materials used chiefly as abrasives, although certain clays, oxides, and substances mentioned later under "Miscellaneous mineral abrasive materials" are not included in the statistics presented herein. On the other hand, certain of the "abrasive materials" for which figures are included have important nonabrasive uses also.

On January 23, 1942, prices of both coated and bonded abrasive products virtually were fixed at the October 1941 level, at the request of the Office of Price Administration. Notification of any subsequent proposed increase in price and of the reasons for such action was required at least a month before the effective date of increase. Coated abrasives include sandpaper, garnet and emery cloth and paper, aluminous oxide cloth, and similar items, whereas bonded abrasives include manufactured grinding wheels, honing sticks, sharpening stones, and similar products.

The effect of grinding, lapping, superfinishing, and similar polishing operations upon metal surface finishes was studied by means of electron diffraction, microscopic experimentation, and corrosion tests.[1] The use of pumice and diatomaceous earth and other natural products, as well as byproduct and processed or expanded aggregates, in lightweight concrete was discussed by Moyer.[2] The occurrences and uses of silica in its many forms, including vein quartz, quartz crystals, tripoli, diatomaceous earth, and gem and ornamental varieties, were described.[3]

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production figures for diatomite since 1926. Total output (sales) for 3-year periods, however, may be shown. Total sales for the three most recent of such periods were as follows—1939–41: 360,502 short tons valued at $5,746,216; 1936–38: 279,645 tons valued

[1] Wulff, J., Metallurgy of Surface Finish: Proc. Conf. Friction and Surface Finish, June 1940, pp. 13–21; abs. Bull. British Nonferrous Metals Research Assc., No. 138, December 1940, p. 332; Ceram. Abs. (Am. Ceram. Soc.), vol. 20, No. 9, September 1941, p. 211.

[2] Moyer, Forrest T., Lightweight Aggregates for Concrete: Bureau of Mines Inf. Circ. 7195, 1942, 26 pp.

[3] Jensen, Nan C., Marketing Silica (Quartz, Tripoli, Diatomite, etc.): Bureau of Mines Inf. Circ. 7202, 1942, 39 pp.

at $4,377,353; and 1933–35: 244,342 tons valued at $3,618,428. Sales during 1941 were at a considerably higher level than in prior years.

California and Oregon remained the principal producing States; other States in which diatomaceous earth was produced in 1941 were Florida, Idaho, Nevada, New Mexico, New York, and Washington (see fig. 1).

Although new uses constantly are being developed, the chief marketing outlets for diatomite are as filter aids; as polish ingredient, especially silver polish; as an insulating material, either in board or as block; and as fillers or admixtures in a variety of products. The diatomaceous earth operations of the Dicalite Co. in Oregon were reported by Manning, [4] who outlined the equipment and processes employed in treatment as well as the uses for which the finished product is adapted. The winning of commercial diatomite from fresh-water bog deposits in Florida, the various grades marketed, and the uses of each type were described.[5]

Quotations on diatomite, as reported in Engineering and Mining Journal Metal and Mineral Markets, remained unchanged throughout 1941, as follows: Crude dried diatomite f. o. b. mines (Nevada), in bulk $7 per ton, in bags $12; low-temperature insulation, $19 per ton; high-temperature insulation $40.

The properties of diatomaceous earth and its uses as a filtering medium, a carrier for catalysts, and a filler, and in the plastics and papermaking industries were discussed by Hall.[6] The effect of chlorine on diatomaceous earth was studied in Great Britain.[7] Using a process developed by the Bureau of Mines,[8] a pilot-plant run on a Maryland diatomite was made to ascertain operating costs and to determine the feasibility of producing this material on a commercial scale.[9]

Use of diatomaceous earth instead of flint in five different types of ceramic glazes resulted in improved gloss and an off-white color, according to Keith.[10] Diatomite as a base for chemical pigments[11] and its use in the match industry[12] were described.

Diatomaceous silica, also known as kieselguhr, was first used in the sugar industry in the United States about 25 years ago. Gradually increased numbers of units of modern filtration equipment were installed, especially after the introduction of faster-flowing filter aids in 1923. By 1930 filter aids of diatomaceous earth were being used by nearly all sugar refineries in the United States and Canada

[4] Manning, Paul D. V., Products from Diatoms Chem. and Met. Eng., vol 48, No. 9, September 1941, pp. 114–115.

[5] Pit and Quarry, Florida Bog Supplies Material Yielding Commercial Diatomite· December 1941, pp. 48–49..

[6] Hall, Howard W., Diatomaceous Silica—How It Serves Industry Pacific Pulp and Paper Ind., vol. 15, April 1941, pp. 50–53, Chem. Abs., vol. 35, No. 19, October 10, 1941, p 6743.

[7] Barrett, L. R., Richardson, H. M , and Green, A T., Action of Chlorine on Refractory Materials. III.—Diatomaceous Earth Bull. British Refractory Research Assc , No. 57, 1940, p. 19; Ceram. Abs (Am. Ceram. Soc.), vol 21, No 1, January 1942, p 13

[8] Norman, James, and Ralston, Oliver, Purification of Diatomite by Froth Flotation. Am. Inst. Min. and Met. Eng. Tech. Pub. 1198, New York, 1940, 11 pp , Min. Technol., vol 4, No. 3, May 1940

[9] Ralston, Oliver C., and Stern, A George, Report of the Nonmetals Division, Fiscal Year 1941: Bureau of Mines Rept. of Investigations 3599, 1941, p. 23

[10] Keith, Wendell P., Comparison of Flint and Diatomite as a Source of Silica in Ceramic Glazes; 44th Annual Meeting, Am Ceram. Soc., April 19–23, 1942; abs. Bull. Am. Ceram. Soc., vol. 21, No. 4, April 15, 1942, p. 18.

[11] Burwell, E. C., Diatomaceous Earth Base for Chemical Pigments: Ind. and Eng. Chem., ind. ed., vol. 33, No. 7, July 1941, pp. 915–918.

[12] Crass, M. F., Jr., The Match Industry; Raw Materials Employed: Chem. Ind., vol. 48, No. 4, April 1941, pp. 424–433.

and by many refineries and other types of sugar factories in different countries,[13] particularly beet-sugar factories. Methods and equipment have frequently been developed and improved. Use, equipment, modern procedures, and the results obtained in sugar refineries by diatomaceous earth filter technique were discussed in a series of articles in the technical press.[14]

Tripoli.—The total quantity of tripoli (including Pennsylvania rottenstone) sold was slightly less in 1941 than in 1940—29,301 short tons compared with 30,212 tons; the value of sales, however, rose 15 percent to $421,746 from $366,569 in 1940. Tripoli or amorphous silica was produced in the same States as in 1940, the output coming largely from Illinois, Missouri, and Oklahoma; other States reporting production were Arkansas, California, Pennsylvania (rottenstone), and Texas.

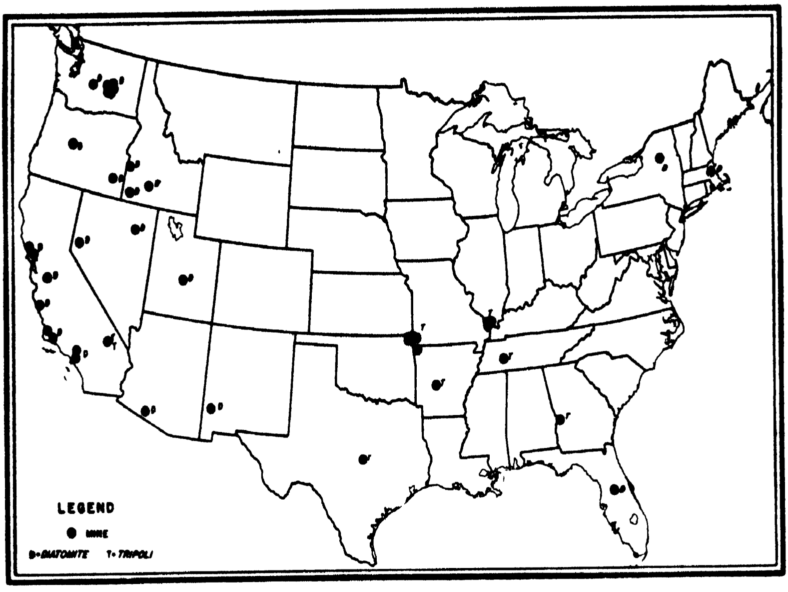

FIGURE 1.—Geographical distribution of diatomite and tripoli mines in the United States.

According to Engineering and Mining Journal Metal and Mineral Markets, prices of tripoli remained constant during 1941, as follows [15]: Once-ground through 40-mesh, rose- and cream-colored, $14.50; double-ground through 110-mesh, rose and cream, $16; air-floated through 200-mesh, $26.

[13] Elsenbast, A. S., and Morris, D. C., Diatomaceous Silica Filter-Aid Clarification: Ind. and Eng. Chem., ind. ed., vol. 34, No. 4, April 1942, pp. 412-418.

[14] Cummins, A. B., and Waymouth, C. E., Filtration of Sugar Solutions; Some Factors Determined by Laboratory Test Procedures: Ind. and Eng. Chem., ind. ed., vol. 34, No. 4, April 1942, pp. 392-398. Cummins, A. B., Calcium Phosphates in the Filtration of Sugar Liquors: Ind. and Eng. Chem., ind. ed., vol. 34, No. 4, April 1942, pp. 398-402; Clarifying Efficiency of Diatomaceous Filter-Aids: Ind. and Eng. Chem., ind. ed., vol. 34, No. 4, April 1942, pp. 403-411. Elsenbast, A. S., and Morris, D. C., Work cited in footnote 13.

[15] Quotations are per ton f. o. b. Missouri, in burlap bags, with paper liners, minimum carload, 30 tons.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1937–41

Year	Illinois		Other States [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	11, 647	$151, 154	23, 289	$299, 416	34, 936	$450, 570
1938	8, 141	117, 107	14, 047	211, 974	22, 188	329, 081
1939	11, 134	148, 310	22, 340	318, 070	33, 474	466, 380
1940	11, 521	155, 576	18, 691	210, 993	30, 212	366, 569
1941	13, 833	200, 700	15, 468	221, 046	29, 301	421, 746

[1] 1937–38: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1939: Arkansas, California, Missouri, Oklahoma, Pennsylvania, Tennessee, and Texas; 1940–41: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Texas.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1939–41, by uses

Use	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives	10, 953	$169, 370	10, 279	$119, 609	13, 407	$198, 252
Concrete admixture	1, 653	24, 580	1, 683	15, 895	1, 179	15, 168
Filler	9, 016	120, 284	8, 451	113, 862	10, 020	145, 063
Oil-well drilling	(1)	(1)	1, 840	16, 949	1, 925	22, 835
Other uses [2]	11, 852	152, 146	7, 959	100, 254	2, 770	40, 428
	33, 474	466, 380	30, 212	366, 569	29, 301	421, 746

[1] Included under "Other uses."
[2] 1939: Foundry facing, oil-well drilling mud, and unspecified; 1940: Filter block, foundry facing, and unspecified; 1941: Foundry facing and unspecified.

Abrasives and fillers remained the largest outlets for tripoli in 1941, each showing a substantial gain over 1940, and combined they represented 80 percent of the total sales compared with 62 percent in 1940. Oil-well drilling made a small gain over 1940, whereas concrete admixture decreased as did "other uses," which in 1941 comprised foundry and unspecified uses.

Quartz.—The output of crude, crushed, and ground quartz from pegmatite veins or dikes and from quartzite in 1941 increased to 41,685 short tons, valued at $228,587, or 31 percent in tonnage and 30 percent in value over 1940. Production was much higher than in any year since 1920. The gain in 1941 in total sales of quartz was due to the greatly increased sales of crude and crushed material, as 19 percent less ground quartz was sold than in 1940; however, except for 1940, the quantity was larger in 1941 than in any year since 1935.

Quartz (crude, crushed, and ground) [1] *sold or used by producers in the United States, 1937–41*

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	3, 252	$10, 096	5, 891	$24, 652	3, 869	$31, 293	13, 012	$66, 041
1938	4, 493	17, 023	9, 930	27, 941	4, 188	43, 233	18, 611	88, 197
1939	13, 739	45, 785	15, 504	49, 186	5, 716	58, 067	34, 959	153, 038
1940	3, 606	17, 099	17, 652	58, 897	10, 607	100, 394	31, 865	176, 390
1941	8, 977	39, 247	24, 101	94, 913	8, 607	94, 427	41, 685	228, 587

[1] To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

An output of quartz in 1941 was reported from 15 States compared with 13 in 1940. (See fig. 2). No sales in 1941 were reported from Virginia; and States producing in 1941 but not in 1940 were New Hampshire, Ohio, and Texas. Otherwise the same States furnished quartz in both years.

Quartz (crude, crushed, and ground) [1] *sold or used by producers in the United States, 1939–41, by States*

State	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	8,442	$37,410	2,141	$25,548	3,974	$50,243
California						
Oregon	910	5,600	1,600	10,000		
Maine	644	1,725	160	538	202	722
Maryland	515	8,010	(2)	(2)	(2)	(2)
Massachusetts	442	2,352	786	4,716	850	5,525
New Jersey	----	----	(2)	(2)	778	7,181
Pennsylvania	----	----	(2)	(2)		
Ohio	(2)	(2)	----	----		
North Carolina	3,702	22,824	3,842	25,063	(2)	(2)
Virginia					----	----
Texas	----	----	----	----	1,485	14,345
Other States [3]	20,304	74,817	23,336	110,525	34,396	150,571
	34,959	153,038	31,865	176,390	41,685	228,587

[1] To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Included under "Other States."
[3] 1939: New York, Ohio, Tennessee, and Wisconsin; 1940: Maryland, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin; 1941: Maryland, New Hampshire, New York, North Carolina, Tennessee, and Wisconsin.

Ground sand and sandstone.—Sales of ground sand and sandstone in 1941 (487,665 short tons) were the largest ever recorded except in the war peak year 1917; the value of sales ($3,073,730), however, was over two and a half times that in 1917 and 43 percent greater than the previous high value of $2,146,464 in 1936. States producing substantial tonnages in 1941 were Illinois, New Jersey, Ohio, and Pennsylvania (see fig. 2).

Ground sand and sandstone sold or used by producers in the United States, 1937-41

Year	Short tons	Value	Year	Short tons	Value
1937	328,156	$1,996,528	1940	342,218	$2,088,314
1938	237,167	1,425,445	1941	487,665	3,073,730
1939	310,512	1,930,301			

Ground sand and sandstone sold or used by producers in the United States, 1940-41, by States

State	1940		1941	
	Short tons	Value	Short tons	Value
California	5,505	$39,080	(1)	(1)
Illinois	106,397	628,488	131,581	$808,402
Massachusetts	1,425	6,240	1,352	6,327
New Jersey and Pennsylvania	122,304	641,021	174,305	954,929
Ohio, Virginia, and West Virginia	96,133	688,321	149,542	1,092,784
Other States [2]	10,454	85,164	30,885	211,288
	342,218	2,088,314	487,665	3,073,730

[1] Included under "Other States."
[2] 1940: Missouri, North Carolina, and Wisconsin; 1941: California, Missouri, and Wisconsin.

As in 1940, the three principal uses for ground sand and sandstone in 1941 were pottery, porcelain, and tile (38 percent of the total), abrasives (21 percent), and foundries (16 percent), or 75 percent of the total quantity marketed for these uses compared with 83 percent in 1940. Consumption for all the uses indicated in the accompanying table showed considerable increases over 1940; for example, the amount used in glass manufacture, fourth-largest use in 1941, was over three and a half times that consumed for this purpose in 1940.

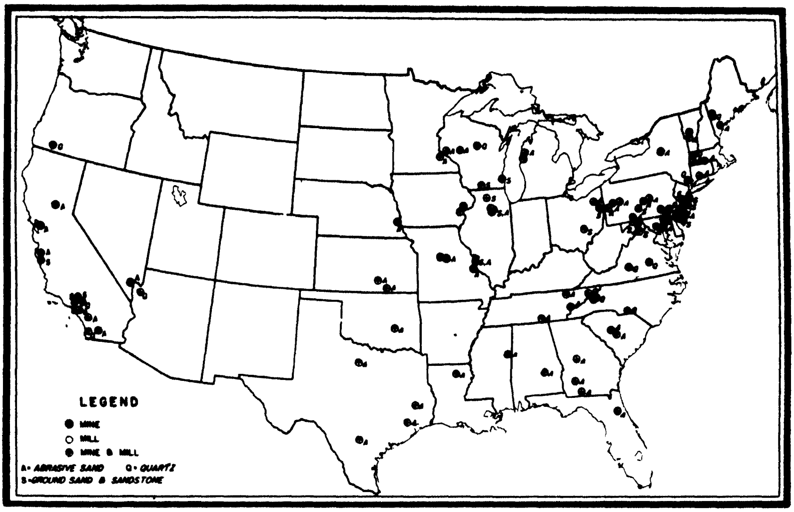

FIGURE 2.—Geographical distribution of plants producing quartz, abrasive sand, and ground sand and sandstone in the United States.

Ground sand and sandstone sold or used by producers in the United States in 1941, by uses

Use	Short tons	Value: Total	Value: Average per ton
Abrasive:			
Cleansing and scouring compound	76, 557	$415, 043	$5. 42
Other	26, 273	155, 954	5. 94
Enamel	30, 983	175, 891	5. 68
Filler	17, 473	132, 647	7. 59
Foundry	77, 699	459, 750	5. 92
Glass	35, 666	243, 119	6. 82
Pottery, porcelain, and tile	183, 691	1, 280, 761	6. 97
Other uses	39, 323	210, 565	5. 35
	487, 665	3, 073, 730	6. 30

Abrasive sands.—Production of natural sands with a high silica content, employed for sand blasting, scouring stone, grinding glass, sandpaper, and other abrasive uses, rose in 1941 to 1,001,814 short tons valued at $1,388,966 from 856,309 tons valued at $915,925 in 1940, or 17 percent in tonnage and 52 percent in value. It was only slightly less than that in 1937—1,067,178 tons valued at $1,440,736. The 1941 total includes 371,049 tons of blast sand valued at $912,626—45 percent more in quantity and 53 percent in value than the 256,104 tons valued at $597,198 reported for 1940.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and pulpstones.—Total sales of grindstones and pulpstones in 1941 rose to 15,536 short tons valued at $545,556, or 17 percent in tonnage and 10 percent in value over 1940, although the output of pulpstones fell sharply. Both the tonnage and value of grindstones sold in 1941 were over 50 percent greater than in 1940 and higher than in any recent year. Approximately equal to the 1930 output, the total for 1941 remained considerably under the annual production for the decade ended with 1929. Owing chiefly to the severe competition of manufactured pulpstones made from aluminum oxide, production of natural pulpstones decreased 57 percent in tonnage and 47 percent in value from 1940. As in other recent years, grindstones were quarried in Ohio and West Virginia and pulpstones in Washington and West Virginia.

Grindstones and pulpstones sold by producers in the United States, 1937–41

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
1937	11,617	$352,377	761	2,924	$220,331
1938	4,653	149,019	417	1,553	90,987
1939	7,917	257,350	672	2,517	169,025
1940	8,790	284,809	901	4,533	211,639
1941	13,573	434,208	685	1,963	111,348

Oilstones and related products.—Sales of natural sharpening stones—including oilstones, whetstones, scythestones, and rubbing stones—decreased somewhat in 1941 compared with 1940. As in 1940, however, the Bureau of Mines is not at liberty to publish the figures. States that contributed to the total in 1941 and the type of stone reported from each were as follows: Arkansas, oilstones and whetstones; Indiana, scythestones and rubbing stones; New Hampshire, scythestones, whetstones, and lathestones; and West Virginia, rubbing stones.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	810	$112,841	1940	(1)	(1)
1938	511	130,277	1941	(1)	(1)
1939	620	115,805			

1 Bureau of Mines not at liberty to publish figures

Millstones.—The value of millstones sold in 1941 rose to $15,579, or 138 percent above 1940 and 41 percent above 1939—the highest recent year. However, it was much less than the annual values recorded before 1930. In 1941 millstones were produced in Ulster County, N. Y.; Rowan County, N. C.; Montgomery County, Va.; and near Morgantown, W. Va. (see fig. 3). Output of chasers also was reported by two producers in New York.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1937–41

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1937	6	(2)	2	(2)	8	$8,305
1938	4	(2)	2	(2)	6	3,743
1939	6	$2,584	3	$8,500	9	11,084
1940	3	(2)	2	(2)	5	6,558
1941	5	3,558	3	12,021	8	15,579

[1] 1937–38: Virginia; 1939–40: North Carolina and Virginia; 1941: North Carolina, Virginia, and West Virginia.
[2] Bureau of Mines not at liberty to publish figures.

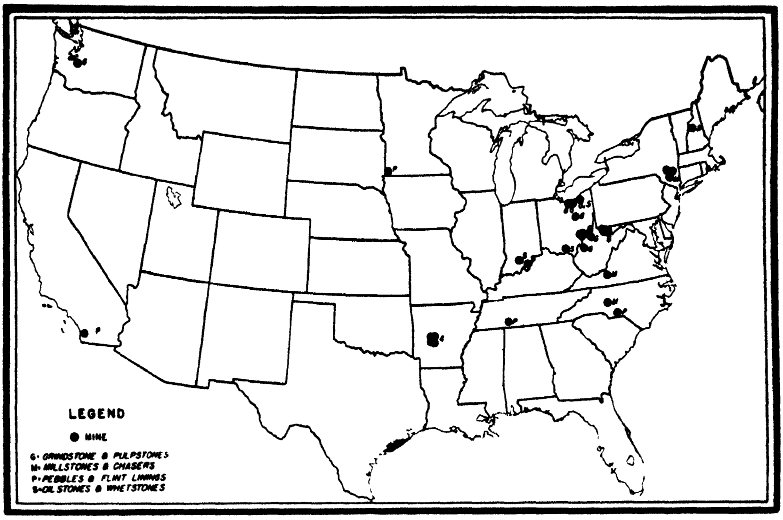

FIGURE 3.—Geographical distribution of sources of grindstones and pulpstones, millstones and chasers, pebbles (grinding), and tube-mill linings (flint linings), and oilstones and whetstones in the United States.

Grinding pebbles and tube-mill liners.—Because of the curtailment of receipts of foreign pebbles and liners—chiefly Danish and French pebbles and Belgian silex liners—strenuous efforts have been made to locate and market domestic materials. For many years, the principal domestic supply has come from quartzite deposits in Minnesota or from southern California beaches. Materials tested include shaped liners and tumbled cubes of granite, quartzite other than the Minnesota material, and quartz pebbles and other rounded or shaped rocks from Canada, Newfoundland, and the United States. Some of these have given, under difficult conditions, service as good as or better than the imported products.

In response to this increased interest in domestic sources, a number of new producers entered the field, and the sales of grinding pebbles and tube-mill liners in 1941 rose to 16,972 short tons valued at $276,042—somewhat higher than the tonnage and more than twice the value in 1917, the previous high year. Of the total for 1941, grinding pebbles represented 13,561 tons valued at $221,826 and tube-mill liners 3,411 tons valued at $54,216.

In 1941 the principal commercial producer of grinding pebbles and tube-mill liners was the Jasper Stone Co., Sioux City, Iowa, which marketed liners and artificially rounded quartzite pebbles from near Jasper, Minn. In California, John C. Momand, Carlsbad, again produced beach pebbles (mostly of granite, with no flint pebbles); the Crystal Silica Co., Los Angeles, and the Ocean Rock & Sand Co., Oceanside, also sold some grinding pebbles. Charlotte Chemical Laboratories, Inc., Charlotte, N. C., which in 1940 operated as the Southern Products & Silica Co., produced granite liners, rounded granite cubes, and milled-silica (quartz) pebbles; the Harris Granite Quarries Co., Salisbury, N. C., marketed both liners and rounded granite cubes; and Peeler & McCombs, Faith, N. C., sold granite pebbles and liners. Quartzite liners were produced by J. Howard Swaim, 918 Cotton States Bldg., Nashville, Tenn., from deposits near Iron City, Tenn.

Texas flint pebbles were marketed in 1941 by Philip S. Hoyt, Columbus, Tex., and the Dezendorf Marble Co., Austin, Tex.; these pebbles are said to be nearly as tough as the Danish pebbles formerly imported. Philip S. Hoyt produced some liners also. Another new source was the Baraboo Quartzite Co., Baraboo, Wis., which produced quartzite pebbles in Sauk County, Wis.

In 1942 Texas pebbles are being marketed also by The Richard L. Cawood Co., 1250 St. George St., East Liverpool, Ohio. Grinding pebbles produced near Elmore, Ala., are sold through the Great Lakes Foundry Sand Co., United Artists Bldg., Detroit, Mich.

NATURAL SILICA ABRASIVES

Pumice and pumicite.—Sales of pumice and pumicite in 1941 rose to 117,310 short tons valued at $669,514—an all-time high in both quantity and value; they were 42 percent greater in tonnage than in 1940 and 32 percent above 1939, the previous record year. The total value in 1941 surpassed by 49 percent the 1940 high of $449,914. This large increase reflects both the greater use of pumice as a concrete aggregate in building and the more careful preparation of domestic pumice and its acceptance by consumers in place of the high-quality abrasive grades formerly imported.

Pumice and pumicite sold or used by producers in the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	71,007	$301,936	1940	82,407	$449,914
1938	65,742	312,886	1941	117,310	669,514
1939	89,159	424,780			

Production of pumice and pumicite in 1941 was reported from California, Kansas, Nebraska, New Mexico, Oklahoma, Oregon, and Texas (see fig. 4).

Pumice and pumicite used for concrete aggregate and admixture increased in 1941 to 56,159 short tons, or 155 percent above the 1940 figure. Use in acoustic plaster was 32 percent greater than in 1940. Consumption in abrasives, however, was slightly less than in 1940, although the value increased 62 percent—49,031 tons valued at $392,364 in 1941 compared with 50,195 tons valued at $242,331 in 1940 (see fig. 5).

Pumice and pumicite sold or used by producers in the United States, 1939–41, by uses

Use	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	52,521	$227,447	49,359	$234,768	36,246	$265,361
Other abrasive uses	(1)	(1)	836	7,563	12,785	127,003
Acoustic plaster	5,444	97,181	3,712	67,906	4,885	78,538
Concrete admixture and concrete aggregate	20,719	24,852	22,045	48,204	56,159	72,242
Other uses [2]	10,475	75,300	6,455	91,473	7,235	126,370
	89,159	424,780	82,407	449,914	117,310	669,514

[1] Included under "Other uses."
[2] 1939: Asphalt, heat or cold insulation, or other abrasive use, insecticide, building tile and blocks, roofing, stucco, and unspecified uses; 1940. Asphalt, heat or cold insulation, insecticide, stucco, lime mortar, and unspecified uses; 1941: Asphalt, insulating mediums, insecticide, paint products, and unspecified.

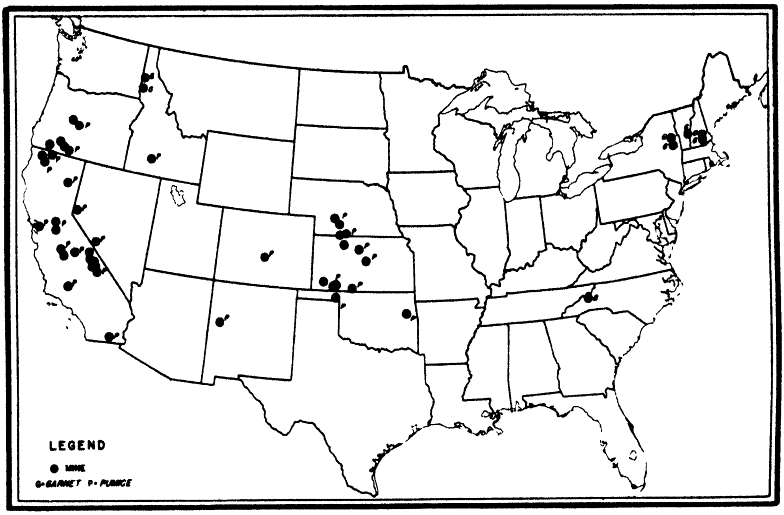

FIGURE 4.—Geographical distribution of garnet mines and pumice and pumicite mines in the United States.

The European War cut off supplies of Italian pumice, which usually has made up the bulk of the high-quality abrasive pumice sold in the eastern United States. Suitable domestic pumice was located in California. Increasingly difficult transportation conditions, however, led to the purchase by eastern importers of the pumice mill at Grants, N. Mex., heretofore operated by the Barnsdall Tripoli Co., Seneca, Mo. Under the name of the Pumice Corporation of America, this plant is now shipping high-grade pumice for abrasive use to eastern markets at an all-rail rate said to be comparable with rates by rail-water routes formerly utilized[16] from California.

A brief paper by Adams [17] described the chemical and physical properties, uses, and economics of pumice and volcanic ash. The

[16] Bureau of Mines, Mineral Trade Notes: Vol. 13, No. 1, July 19, 1941, pp. 22–23; Rock Products, vol. 42, No. 8, August 1941, p. 120.
[17] Adams, James A., Pumice and Pumicite: Oregon State Dept. Geol. and Min. Ind., G. M. I. Short Paper 6, Portland, Oreg., 1941, 7 pp.

pumice deposit of the West Coast Pumice Co. near Chemult, Oreg., and its commercial utilization were described.[18] Pence [19] discussed the advantages of volcanic ash as a ceramic body constituent. After electromagnetic treatment, pumicite may be used in place of feldspar in ceramic bodies whose color has secondary importance. The mechanical strength of pumicite bodies is higher than that of feldspar bodies. Shrinkage is also somewhat higher. Other properties of ceramic mixes containing pumicite are similar to those using feldspar.

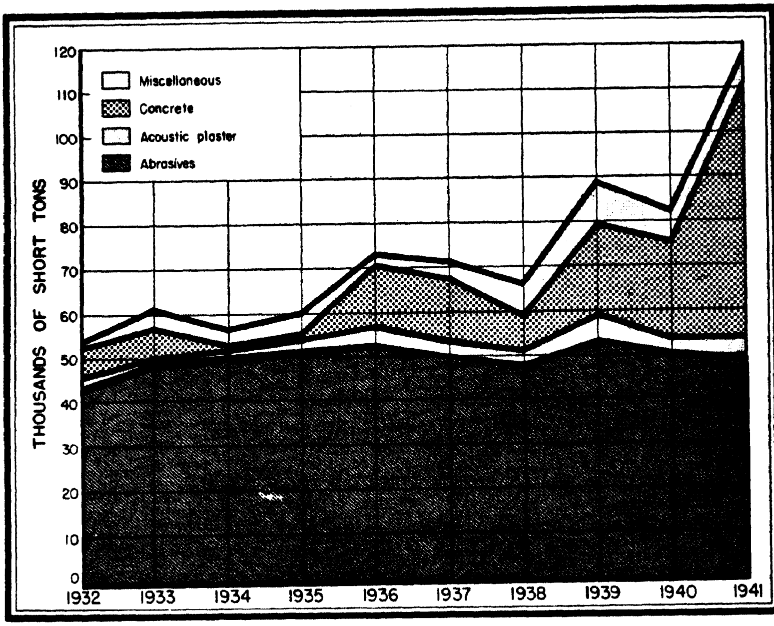

FIGURE 5.—Trends, by uses, of pumice and pumicite sold or used by producers in the United States, 1932–41.

Garnet.—Abrasive garnet sold or used by producers in the United States in 1941 totaled 5,501 short tons valued at $371,752—a gain of 17 percent in tonnage and 43 percent in value over 1940 and higher than in any year since 1929 (fig. 6). Increased industrial activity on account of the munitions program contributed to the increased demand. The outlook for further expansion during 1942 seems favorable. In 1941, as in 1940, output of garnet produced for sale came from New York, North Carolina, Vermont, and Idaho (see fig. 4). After reorganization, Mas-Celo Mines, Inc., Burnsville, N. C., producers of byproduct garnet, took over and continued operation of the properties of Celo Mines, Inc.

Market quotations for garnet at the beginning of 1941, as reported by Engineering and Mining Journal Metal and Mineral Markets, were as follows: New Hampshire, f. o. b. mines, per ton, concentrate, $30; grain, $80 to $140; New York, Adirondack garnet concentrates, grain, $85 per ton; Spanish grades, c. i. f. port of entry, $60 (nominal). These prices held firm throughout the year except for New Hampshire

[18] Mining World, Oregon Pumice Deposit Put to Commercial Utilization: Vol. 3, No. 1, January 1941, p. 30.

[19] Pence, Forrest K., White-Firing Texas Volcanic Ash as a Body Ingredient: Bull. Am. Ceram. Soc., vol. 20, No. 10, October 1941, pp. 327–329.

concentrate, which after August 14 was quoted at $35 per ton, and Spanish garnet which after June 5 rose to $70 per ton, c. i. f. port of entry.

Abrasive garnet sold or used by producers in the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	4,863	$382,535	1940	4,716	$259,345
1938	2,669	191,658	1941	5,501	371,752
1939	4,056	278,534			

A popular account of the garnet, its forms, varieties, and mineral associations, was published.[20] Operations of the Barton Mines Corporation on Gore Mountain near North Creek, N. Y. were described.[21] The garnet-bearing rock is broken by blasting and hauled to a ramp which leads into the mill. After it passes through a roll crusher, the dirt and rock are removed by washing, and the clean garnets are graded for size, dried, and packed in bags for shipment. Some of the product is crushed further, according to customers' orders, but the greater part is sold in sizes as produced. Production averages 12 to 15 tons daily from rock containing 5 to 12 percent garnet.

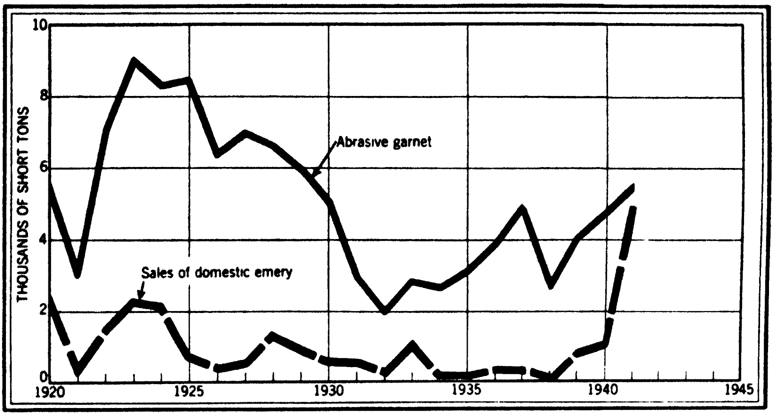

FIGURE 6.—Marketed production of abrasive garnet and domestic emery in the United States, 1920–41.

NATURAL ALUMINA ABRASIVES

Corundum.—Corundum exports from South Africa, chief source of world supply, were consigned chiefly to the United States in 1941. A large plant for the treatment of boulder corundum, to cost about £20,000, was being built in 1941 at Pietersburg, in Northern Transvaal. It is proposed to distribute corundum from Pietersburg direct to Australia, India, and other countries that hitherto have been supplied by way of the United States.[22]

[20] Trainor, John N., An Introduction to the Garnet. Rocks and Minerals, vol. 17, No. 5 (Whole No. 130), pp. 163–167.
[21] Diesel Power and Diesel Transportation, Mining Garnet with Diesel Power. Vol. 19, No. 12, December 1941, pp. 1027–1029.
[22] Mining and Industrial Magazine, Southern Africa, vol 29, November 1941, p. 331; reported in Bureau of Mines Mineral Trade Notes: Vol. 14, No. 2, February 20, 1942, pp 15–16.

The consumption of South African corundum in the United States has increased rapidly during the last few years. The material is crushed and sized, and the coarse grain products are sold to manufacturers of grinding wheels, especially snagging wheels, and the finer-grained products to optical lens grinders. The fine dust (minus-240-mesh) and the secondary materials mixed with glass and reduced in size after use by the optical instrument workers are sold to retail opticians.

With the issuance on February 10, 1942, of War Production Board General Preference Order M-89, corundum was made subject to full allocation. Under the order, corundum used in the manufacture of some civilian products may be curtailed, and suppliers will make deliveries only when specifically authorized by the Director of Industry Operations, War Production Board. The Director will periodically allocate corundum and specifically direct the manner and quantities in which deliveries shall be made. Future allocations may be made without regard to any preference ratings assigned to particular contracts or purchase orders, but they will be made to insure the filling of Government war orders.

Emery.—The production of emery in 1941 rose to 4,876 short tons valued at $42,484—the highest output since World War I when production including a small quantity of corundum, reached 10,422 tons in 1918. In 1941, as in recent years, all the output came from the Peekskill district in southeastern New York State (see fig. 7). Increased shipments were reported by the three producers mining emery in 1941, who also produced in 1940—DiRubbo & Ellis, the Howard Emery Corporation, and Joe DeLuca; in addition, Scalzo & Pisano operated in 1941 and sold their entire output through DeLuca. Mining is conducted by crude hand methods on account of the toughness of the ore, which occurs in veins of norite. Demand is increasing as new uses are being developed. Production at the DeLuca mine in January and February 1942 is said to have been three times that in the corresponding months of 1941.[23]

Emery sold or used by producers in the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	320	$2,780	1940	1,046	$9,349
1938			1941	4,876	42,484
1939	765	6,828			

NATURAL CARBON ABRASIVES[24]

Abrasive or industrial diamonds.—The demand for abrasive or industrial diamonds in the United States is satisfied principally through the importation of black diamonds or carbonados (largely from Brazil) and diamonds for industrial use (chiefly from the Union of South Africa but with increasing importations from Brazil). Some diamond dust and bort also are imported, although usually in comparatively small and decreasing quantities in recent years. Imports of "glaziers' and engravers', unset, and miners' " diamonds (a classification comprising

[23] Rocks and Minerals, vol. 17, No. 3, March 1942, p. 107.
[24] See also chapter on Gem Stones in this volume.

mostly if not entirely diamonds for industrial use) in January–September 1941 continued at approximately the same high average monthly rate as in 1940 and totaled 2,911,117 carats valued at $7,415,133. The average value per carat in 1941 was $2.55, a continuation of the trend since 1929 toward lower values per carat, broken only in 1934 and 1940.

A comprehensive review of the diamond trade in 1940 in all countries of the world, dealing with both mining and cutting operations and treating in detail the South African trade and mining conditions for each of the main factors in the industry, was presented by Ball.[25] Discussion includes an excellent account of the industrial diamond situation and the elements contributing to the greatly augmented consumption of industrial stones in recent years.

A good description of the South African diamond mines, including methods of mining, processing of the "blue earth" to recover the stones, and a brief outline of the methods of cutting and the industrial uses, with several illuminating illustrations, was published.[26] A great amount of information about industrial diamonds, contributed by outstanding authorities in the various phases of the industry, was published in the early part of 1942.[27]

In addition to diamonds and synthetic and natural rubies and sapphires, a number of other hard and tough stones, such as garnet, chrysoberyl, spinel, zircon, topaz, rock crystal, and agate, are used as watch and chronometer jewels, as bearings for meters or other scientific instruments, and for timing instruments, such as mechanical fuses for bombs, switches, and microgears.[28] Details of the chief uses of the various stones are given, as well as a résumé of the shifts in use from one type to another with changing industrial conditions, with particular reference to Montana sapphires.

Stress was placed on the importance of diamond, corundum, emery, and various gem stones, such as synthetic rubies and sapphires and natural rubies, sapphires, and amethysts, used for jewel bearings in watches and in precision instruments of various types.[29] Jewel bearings, their relation to industrial precision instruments for both military and civilian use, and sources of supply of natural and synthetic material were discussed by Jensen.[30]

ARTIFICIAL ABRASIVES

Production of manufactured (artificial) abrasives in 1941 exceeded all previous records, the total quantity reported being 54 percent above 1940 and the value 52 percent above 1929, the previous record years for tonnage and value, respectively. Plants manufacturing aluminum oxide and silicon carbide (see fig. 7) in Canada and the United States operated at full capacity in 1941 and produced 44,962 short tons of silicon carbide valued at $3,325,928 and 147,759 short tons of aluminum oxide valued at $9,067,732—an increase of 36 percent over 1940

[25] Ball, Sydney H., The Diamond Industry in 1940: Jewelers' Circ.-Keystone, New York, 16 pp.
[26] Greeves-Carpenter, C. F., The Power of Diamonds: Compressed Air Mag., vol. 46, No. 2, February 1941, pp. 6357–6361.
[27] Kraus, Ed. H., Ball, Sydney H., and others, Symposium on Diamonds: Am. Mineral., vol. 27, 1942, pp. 162–191 (reprint).
[28] Ball, Sydney H., Precious and Semiprecious Stones, Their Industrial Uses, Particularly in Relation to National Defense: Min. and Met., vol. 22, No. 414, June 1941, pp. 312–313.
[29] Compressed Air Magazine, Industrial Gems (editorial): Vol. 46, No. 2, February 1941, p. 6372.
[30] Jensen, Nan C., Jewel Bearings: Bureau of Mines Mineral Trade Notes, vol. 14, No. 3, March 20, 1942, pp. 26–27.

in tonnage of silicon carbide and 50 percent in tonnage of aluminum oxide. Although manufacturers of metallic abrasives (steel shot and grit) operated at only slightly above 60 percent of capacity, sales of these commodities in 1941 also set an all-time record, rising to 86,309 short tons or 73 percent above the former record (in 1940).

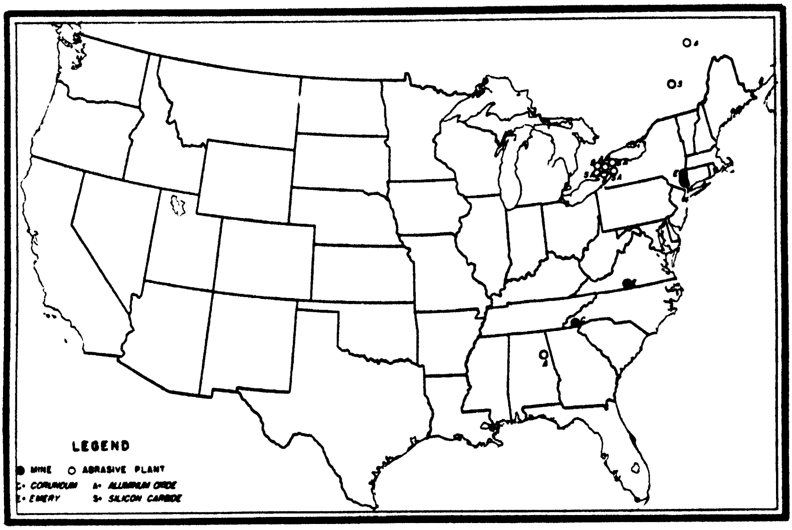

FIGURE 7.—Geographical distribution of corundum and emery deposits in the United States and plants manufacturing aluminum oxide and silicon carbide in the United States and Canada.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada 1937–41 [1]

Year	Silicon carbide [2]		Aluminum oxide [2]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	30,365	$2,215,318	86,401	$4,749,497	28,031	$1,399,772	144,797	$8,364,587
1938	25,346	1,904,925	53,220	3,098,132	25,771	1,234,977	104,337	6,238,034
1939	24,206	1,713,207	50,468	3,047,337	42,015	1,743,859	116,689	6,504,403
1940	33,042	2,359,876	98,531	5,464,986	50,016	2,317,829	181,589	10,142,691
1941	44,962	3,325,928	147,759	9,067,732	86,309	4,050,659	279,030	16,444,319

[1] Bureau of Mines not at liberty to publish data for United States separately.
[2] Production; includes material used for refractories and other nonabrasive uses.

Production of silicon carbide and aluminum oxide is concentrated chiefly in the Niagara Falls region of the United States and Canada, but some output of aluminum oxide comes from Quebec, Canada, and from Alabama. Producers of aluminum oxide in 1941 were requested to report separately the tonnage and value of "white—high-purity or special" aluminum oxide produced. These figures, not segregated heretofore from the total aluminum oxide output, were 22,659 short tons valued at $2,676,753. Estimates based upon percentages reported by producers indicate that 32 percent of the silicon carbide output in 1941 and 3 percent of the aluminum oxide production were consumed for refractory or nonabrasive purposes compared with 32 and 2 percent, respectively, in 1940.

Steel shot and grit are manufactured largely in northern Ohio and in Pittsburgh, Pa., but some comes from Michigan and New Hampshire. Two new plants producing metallic abrasives were reported in 1941—a second mill of the Cleveland Metal Abrasive Co. (Cleveland, Ohio), at Howell, Mich., and the Industrial Metal Abrasives Co., Jackson, Mich.

The physical properties and industrial uses in special refractories of abrasives, such as fused alumina, silicon carbide, and electrically fused magnesia, were discussed by Fisher.[31] Employment of these materials is desirable where operating temperatures are extremely high and high heat transfer is desired, where chemical erosion and mechanical abrasion are severe, and where contamination of the melt must be avoided.

MISCELLANEOUS MINERAL ABRASIVE MATERIALS

In addition to the natural and manufactured abrasive materials discussed, many other mineral substances have abrasive uses. Various oxides, including tin oxide, rouge, crocus, chromium oxide, magnesium oxide, and manganese oxide, are utilized as polishing agents. Finely ground as well as calcined clays, high-grade lime, talc, river silt, slate flour, whiting, feldspar, and other substances also are used as abrasives.

FOREIGN TRADE[32]

In the period January–September 1941 imported crude pumice virtually dropped out of the domestic market and "manufactured"-pumice imports ceased because of the war and the difficulties of transportation from Italy, heretofore by far the chief source of foreign pumice. Receipts of bort also declined sharply. The value of diamond dust, however, was greater than in the full year 1940, and average monthly imports of "glaziers' and engravers', unset, and miners'" diamonds in the first 9 months of 1941 were only slightly less than in the year 1940. Imports of emery ore (from Greece) ceased, although receipts of corundum ore during January–September 1941 were larger than in any full year since 1936.

The total value of exports of natural abrasive materials in the January–September period of 1941 rose about 17 percent compared with the full year 1940, in spite of a severe drop in exports of both grindstones and emery and corundum abrasive wheels. The value of "All other natural abrasives, whetstones, hones, etc." exported during January–September 1941, however, jumped to $1,716,054—42 percent above the entire year 1940 and higher than in any year since 1921.

[31] Fisher, Henry C., Abrasives in the Role of Superrefractories: Metal Prog., vol. 40, No. 2, 1941, pp. 177-282, Ceram. Abs. (Am Ceram Soc.), vol. 21, No. 2, February 1942, p. 42.

[32] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce

Abrasive materials imported for consumption in the United States, 1939–41, by kinds

Kind	1939		1940		1941 (Jan.-Sept.)	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones:						
Rough or unmanufactured short tons	(1)	$52				
Bound up into millstones do	31	1,678	40	$2,167	12	$685
Grindstones, finished or unfinished do	838	26,059	634	18,275	370	9,743
Hones, oilstones, and whetstones do	68	48,261	37	42,482	20	26,120
Emery:						
Ore do	2,191	29,318	5,718	73,935		
Grains, ground, pulverized, or refined pounds	(2)	(2)	(2)	(2)	(2)	(2)
Paper and cloth of emery or corundum	(3)	72,966	(3)	91,112	(3)	57,639
Wheels, files, and other manufactures of emery or corundum or garnet pounds	10,604	5,043	4,348	2,473	723	417
Corundum (see also "Emery"):						
Ore short tons	1,964	104,724	2,922	165,270	4,022	193,345
Grains, ground, pulverized, or refined pounds	[2] 129,237	[2] 9,793	[2] 134,606	[2] 9,262	[2] 86,306	[2] 3,427
Tripoli and rottenstone short tons	218	2,769	227	3,767	364	7,563
Pumice:						
Crude or unmanufactured do	6,656	36,463	3,758	20,771	29	671
Manufactures of, or of which pumice is the component material of chief value	(4)	29,221	(4)	6,468		
Diamond:						
Bort carats	1,381	34,618	785	19,660	61	1,025
Dust	(4)	4,278	(4)	2,515	(4)	2,805
Glaziers' and engravers', unset, and miners' carats	3,568,730	9,725,663	3,809,071	11,026,563	2,911,117	7,415,133
Flint, flints, and flint stones, unground short tons	11,987	116,019	2,840	32,397	1,195	14,390
		10,246,945		11,517,117		7,732,963

[1] Less than 1 ton.
[2] Emery included with corundum; not separately classified
[3] 2,479 reams in 1939, 1,562 reams in 1940, 1,891 reams in 1941; weight not recorded.
[4] Quantity not recorded.

Value of domestic abrasive materials exported from the United States, 1937–41

Material	1937	1938	1939	1940	1941 [1]
Grindstones	$193,112	$122,720	$173,575	$215,156	$89,100
Abrasive wheels, emery and corundum	140,022	116,456	125,303	179,514	79,784
All other natural abrasives, whetstones, hones, etc.	826,955	835,894	1,116,711	1,211,291	1,716,054

[1] January to September, inclusive.

SULFUR AND PYRITES

By Allan F. Matthews and A. W. Mitchell [1]

SUMMARY OUTLINE

GENERAL SUMMARY

Spurred by the call for immense quantities of war products and nutritious food, world production of sulfur reached the highest rate in its history during 1941. Sulfur flowed in unprecedented quantities from the Gulf coast mines—largest in the world—to the industries of the United Nations. In the other camp, the Axis countries found their sulfur sources ample, although supplies at consumption centers apparently were not adequate at all times. Italy's economic dependence on Germany was alleviated to some extent by a large exportable surplus of sulfur. Not only Italian sulfur but also pyrites from Scandinavia, Germany proper, Yugoslavia, Poland, and other Continental regions, augmented by increased recoveries from industrial gases, contributed to the Reich's sulfuric acid supply. The volcanoes that built the Japanese archipelago make it self-sufficient in sulfur. Spain, normally the most important source of pyrites, suffered a mining slump in 1941 and, aside from some exports to the United States and Great Britain, consumed most of its pyrites domestically.

In the United States production of both sulfur and pyrites broke all previous records during 1941, and shipments of sulfur from the mines were a third higher than ever before. Native sulfur produced in the United States through 1941 has totaled more than 50 million long tons; virtually the entire quantity has been mined since 1900. The principal trends in the sulfur and pyrites industries are shown in figures 1 and 2. Mine stocks of sulfur at the close of 1941 were sufficient to last over a year, even at the increased current rate of consumption. New acid-plant capacity totaling more than 1,000 tons a day of sulfuric acid (100-percent basis) went into operation in 1941, according to Chemical and Metallurgical Engineering, and additional capacity planned for 1942 amounts to some 1,700 tons daily. No priorities were imposed on sulfur, pyrites, or sulfuric acid by the Office of Production Management in 1941. Prices of these commodities were under the surveillance of the Office of Price Administration but remained steady without official action. Early in 1942

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

one of the largest American sulfur producers announced that there would be no rise in the base price of the mineral during the coming year. However, rerouting of domestic shipments from coastwise traffic to rail and inland waterway is certain to increase the delivered price.

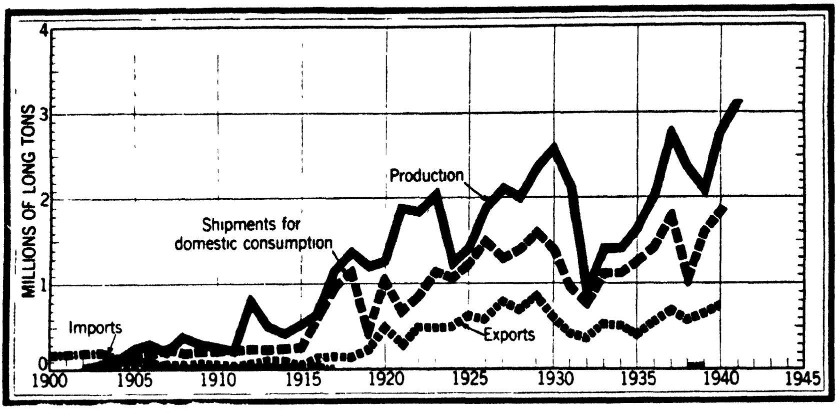

FIGURE 1.—Domestic production, shipments for domestic consumption, exports, and imports of crude sulfur, 1900–1941.

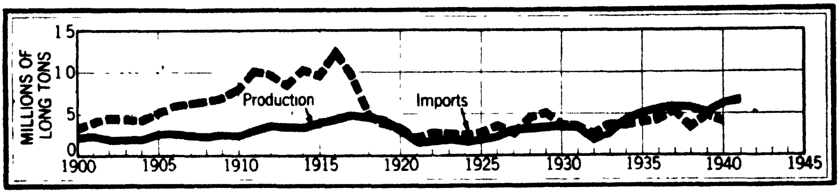

FIGURE 2.—Domestic production and imports of pyrites, 1900–1941.

Salient statistics of the sulfur industry in the United States, 1925–29 (average) and 1938–41

	1925–29 (average)	1938	1939	1940	1941
Sulfur:					
Production of crude sulfur..long tons..	1,951,034	2,393,408	2,090,979	2,732,088	3,139,253
Shipments of crude sulfur					
For domestic consumption..do....	1,397,411	1,049,740	1,605,998	1,812,274	(1)
For export..................do....	707,175	579,107	627,819	746,468	[2] 474,551
Total shipments............do....	2,104,586	1,628,847	2,233,817	2,558,742	3,401,410
Imports.					
Ore........................do....	1,896	51	35	(3)	....
Other......................do....	295	2,552	13,941	27,845	[2] 20,954
Exports of treated sulfur.........do....	11,956	12,707	25,005	19,745	[2] 24,683
Producers' stocks at end of year.do....	2,413,000	4,200,000	4,000,000	4,200,000	3,900,000
Price of crude sulfur f. o. b. mines per long ton..	$17.50	$16–18	$16	$16	$16
Pyrites:					
Production..................long tons..	273,936	555,629	[4] 519,497	[4] 626,640	659,498
Imports......................do....	372,958	334,234	482,336	407,004	[2] 224,264
Price of imported pyrites c. i. f. Atlantic ports cents per long-ton unit..	12–13	12–13	12–13	12–13	12
Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants........................short tons..	1,118,453	687,176	778,441	840,937	915,989

[1] Bureau of Mines not at liberty to publish figures.
[2] Figures cover January to September, inclusive.
[3] Less than 1 ton.
[4] Revised figures.

A sound motion-picture film, The Story of Sulfur, available for exhibition to responsible organizations, was prepared in 1941 under the supervision of the Bureau of Mines in cooperation with one of the principal sulfur-producing companies. Duecker and Eddy,[2] in an excellent article, reviewed some of the influences of sulfur in the development of American industry. The tribunal that studied the effects of sulfurous gases from the smelter at Trail, British Columbia, reported its decision in 1941.[3]

SULFUR

DOMESTIC PRODUCTION

Production of crude sulfur in the United States in 1941 attained a new record of 3,139,253 long tons, a 15-percent gain over the 1940 output. Mine shipments in 1941, exceeding those of 1940 by 33 percent, were likewise the highest ever reported. The United States sulfur-production figures do not include 414 long tons in 1941 and 330 in 1940 of sulfur-bearing material containing 12 to 70 percent sulfur and mined in Colorado, Nevada, and Texas for agricultural purposes.

Sulfur produced and shipped in the United States, 1937–41

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1937	2,741,970	2,466,512	$44,300,000	1940	2,732,088	2,558,742	$40,900,000
1938	2,393,408	1,628,847	27,300,000	1941	3,139,253	3,401,410	54,400,000
1939	2,090,979	2,233,817	35,500,000				

THE INDUSTRY IN 1941 BY STATES

Nearly 83 percent of the domestic sulfur output in 1941 was from Texas, 17 percent from Louisiana, and less than 1 percent from California. No sulfur was mined in Utah in 1941.

Sulfur produced in the United States, 1937–41, by States, in long tons

Year	Texas	Louisiana	Other States [1]	Total
1937	2,392,680	342,230	7,060	2,741,970
1938	2,060,845	328,405	4,158	2,393,408
1939	1,665,400	422,600	2,979	2,090,979
1940	2,212,839	512,935	6,314	2,732,088
1941	2,596,731	533,620	8,902	3,139,253
	10,928,495	2,139,790	29,413	13,097,698

[1] 1937–40: California and Utah; 1941: California.

California.—Two operators—Paul Barnes and the Pacific Sulphur Co., at Bigpine, Inyo County—supplied the 1941 output.

Louisiana.—In 1941, for the fifth successive year, production was confined to that of the Freeport Sulphur Co., at Grande Ecaille, Port Sulphur, Plaquemines Parish.

[2] Duecker, W. W., and Eddy, E. W., Sulfur's Role in Industry: Chem. Ind., vol. 50, No. 2, February 1942, pp. 174–182.

[3] Trail Smelter Arbitration Between the United States and Canada, Decision of the Tribunal, Reported March 11, 1941, U. S. Govt. Printing Office, 1941, 61 pp.

Texas.—The sulfur properties active in 1941 included those of the Duval Texas Sulphur Co. at Orchard Dome, Fort Bend County, and at Boling Dome, Boling, Wharton County; Freeport Sulphur Co. at Hoskins Mound, Brazoria County; Jefferson Lake Sulphur Co., Inc., at Clemens Dome, Brazoria County; and Texas Gulf Sulphur Co. at Boling Dome, Newgulf, Wharton County. Exploration for sulfur is being undertaken on Spindletop Dome, Jefferson County. The following table, compiled from information issued by the Texas State Comptroller's Office, shows the quarterly production of sulfur in Texas during 1941.

Sulfur produced in Texas in 1941, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co.	361,746	385,208	481,093	611,344	1,839,391
Freeport Sulphur Co.	85,545	93,470	93,365	99,200	371,580
Duval Texas Sulphur Co.	47,720	46,727	48,495	58,540	201,482
Jefferson Lake Sulphur Co., Inc.	52,675	51,979	46,123	33,501	184,278
	547,686	577,384	669,076	802,585	2,596,731

Utah.—Elemental sulfur has been produced from smelter gases since 1940 at Garfield, Salt Lake County, by the American Smelting & Refining Co. as a byproduct of copper operations. It was expected that the initial output would be 2 long tons a day. This quantity is not included in the figures showing total United States sulfur production.

Washington.—A sulfur deposit on Mount Adams, Yakima County, estimated in 1935 to contain 842,000 long tons of material averaging 46 percent sulfur, has been explored further by Pacific Sulphur Mines, Inc., which reports that larger quantities of sulfur are present.

RECOVERY AS BYPRODUCT

The treatment of copper and zinc ores yields large quantities of sulfur, which is recovered at the mills as pyrites concentrate or at the smelters as sulfuric acid. The production of pyrites concentrate is discussed in the Pyrites section of this chapter. In smelting copper and zinc concentrates, sulfur is driven off as sulfur dioxide gas, which is used in the manufacture of sulfuric acid at many smelters. Means of increasing the recovery of sulfur dioxide from smelter gases have been described by the Bureau of Mines.[4] The equivalent of about 180,000 long tons of sulfur was recovered as sulfuric acid annually from this source during the 5 years ended in 1941. Such sulfur is not included in the sulfur-production figures for the United States, but the following table shows the output of byproduct acid at both copper- and zinc-smelting plants. The acid reported is only that made from the sulfur content of sulfide ores but does include, for 1937 to 1938, inclusive, the relatively small quantity of acid made from pyrites concentrate in Wisconsin.

[4] Miller, Virgil, Bainbridge, R., and Ellison, R., Increasing the Concentration of Sulfur Dioxide in the Effluent Gases from Dwight-Lloyd Sintering Machines Treating Lead Products. Bureau of Mines Tech. Paper 624, 1941, 34 pp.

Byproduct sulfuric acid [1] *(expressed as 60° B.) produced at copper and zinc plants in the United States, 1937–41, in short tons*

	1937	1938	1939	1940	1941
Copper plants [1]	291,638	220,297	249,569	254,025	243,812
Zinc plants	542,356	466,879	528,872	586,912	672,177
	833,994	687,176	778,441	840,937	915,989

[1] Includes a small amount of sulfuric acid produced as a byproduct in the roasting of high-sulfide gold and silver concentrates.

Byproduct sulfur is also recovered from coke-oven gas, water gas, refinery-still gas, natural gas, and other fuel gases. A pictorial flow sheet of the recovery of sulfuric acid from waste oil-refinery sludges was published in 1941.[5] For a long time, hydrogen sulfide has been removed from manufactured gases by passing the gas through trays of iron hydroxide to form iron sulfide, known as spent oxide. This material has been used as a source of sulfur in Europe but not to any appreciable extent in the United States. During the last decade, however, the recovery of sulfur from fuel gases has been expanding in this country as a result of developments in various liquid-purification processes. Not all such processes are designed to permit recovery of sulfur as a byproduct, but those that do may be divided into two classes—those that recover elemental sulfur and those that give hydrogen sulfide as an end product. The latter have received increasing attention in recent years. Typically, processes that recover elemental sulfur operate on manufactured fuel gases, whereas those that recover hydrogen sulfide are applied to refinery-still gas and natural gas, and usually these gases are under high pressure. Investigation has indicated, however, that the phenolate processes, at least, are adapted to the removal and recovery of sulfur from low-pressure, low-sulfur gases, such as coke-oven gas.

Most of the elemental sulfur recovered from gas purification results from operations using the Thylox process; relatively minor quantities are recovered from the Ferrox and Nickel processes. Production in 1941 (reduced to 100 percent sulfur) totaled 5,493 long tons; 4,866 tons valued at $136,000 were shipped. Output came from Illinois, Maryland, Massachusetts, Missouri, New Jersey, New York, Washington, West Virginia, and Wisconsin; Massachusetts and New York were the largest producers. The sulfur is produced and marketed either as a paste containing 37 to 50 percent sulfur or as a dried, relatively pure sulfur. The fine particle size of this sulfur makes it valuable as a fungicide and insecticide for agricultural purposes. Of the 1941 shipments (reduced to 100 percent sulfur), 34 percent was in the form of paste and the remainder was dried sulfur.

Most of the hydrogen sulfide recovered as a byproduct from fuel gases is either converted to sulfuric acid or burned as fuel. Recovery is by the phenolate, phosphate, and Girbotol processes. In 1941 the output of hydrogen sulfide extracted from fuel gases (and, for the most part, converted to sulfuric acid) was equivalent to 21,197 long tons of sulfur. Most of this was recovered by petroleum refineries in California and the remainder by companies in Illinois, New Jersey, Pennsylvania, and Texas.

[5] Chemical and Metallurgical Engineering, vol. 48, No. 5, May 1941, pp. 144–147.

The figures on byproduct yield of sulfur from gas purification are not included in the sulfur-production figures for the United States.

The reactions of sulfur dioxide from waste gases with oxide ores and common salt in the direct production of anhydrous sulfates and chlorides were studied recently.[6]

STOCKS

As shipments exceeded production in 1941, stocks at the mines decreased 300,000 long tons during the year and on December 31 amounted to 3,900,000 tons.

PRICE

The price of crude sulfur held to the level of recent years and was quoted by trade journals throughout 1941 at $16 a long ton, f. o. b. mines. Sulfuric acid, 66° B., continued to be listed at $16.50 a short ton.

CONSUMPTION

Apparent domestic consumption of sulfur in recent years is shown in the following table, although data for 1941 are incomplete as the figures for imports and exports cover only the first 9 months of the year.

Apparent consumption of sulfur in the United States, 1937–41, in long tons

	1937	1938	1939	1940	1941
Shipments	2,466,512	1,628,847	2,233,817	2,558,742	3,401,410
Imports	628	2,603	13,976	27,845	[1] 20,954
	2,467,140	1,631,450	2,247,793	2,586,587	([2])
Exports:					
Crude	675,297	579,107	627,819	746,468	[1] 474,551
Refined	13,533	12,707	25,005	19,745	[1] 24,683
	688,830	591,814	652,824	766,213	[1] 499,234
Apparent consumption	1,778,310	1,039,636	1,594,969	1,820,374	([2])

[1] Figures cover January to September, inclusive.
[2] Figures not available.

The consumption of sulfur in various industries from 1937 through 1941 has been estimated by Chemical and Metallurgical Engineering as follows:

Sulfur consumed in the United States, 1937–41, by uses, in long tons [1]

Use	1937 [1]	1938 [1]	1939	1940	1941
Chemicals	777,000	484,000	695,000	800,000	[2] 1,060,000
Fertilizer and insecticides	415,000	220,000	370,000	410,000	450,000
Pulp and paper	302,000	174,000	240,000	320,000	360,000
Explosives	68,000	50,000	64,000	74,000	[2] 83,000
Dyes and coal-tar products	49,000	40,000	46,000	51,000	65,000
Rubber	37,000	29,000	43,000	47,000	55,000
Paint and varnish	64,000	50,000	49,000	54,000	65,000
Food products	6,000	5,500	6,000	6,000	6,000
Miscellaneous	82,000	47,500	82,000	86,000	95,000
	1,800,000	1,100,000	1,595,000	1,848,000	2,239,000

[1] Figures for 1937 and 1938 are not truly representative of consumption but rather of shipments to these specified industries. In 1938 consumers carried over large stocks from 1937, so that actual consumption in 1937 was less than the figures indicate and consumption in 1938 was larger than the total shown.
[2] To avoid disclosing estimated consumption of sulfur in direct defense applications, such as military explosives, sulfur so used in 1941 is included under "Chemicals."

[6] Johnstone, H. F., and Darbyshire, R. W., Sulfur Dioxide as a Raw Material: Ind. and Eng. Chem., Ind. ed., vol. 34, No. 3, March 1942, pp. 280–286.

Most of the sulfur and pyrites are consumed as sulfuric acid—one of the most universally required of heavy chemicals. Production of sulfuric acid (50° B. basis) in the United States, as estimated by Chemical and Metallurgical Engineering, was 10,944,000 short tons in 1941 compared with 9,174,000 tons in 1940.[7] Consumption of sulfuric acid in 1941 increased 20 percent over 1940. The largest consumer—the fertilizer industry—used 11 percent more acid than in 1940 as a result of increased demand for superphosphate. It is estimated that this industry will need about 2,980,000 tons of acid in 1942, an increase of approximately 18 percent over 1941.[8] The iron and steel industry needed 21 percent more sulfuric acid in 1941 than in 1940, primarily for pickling purposes and the recovery of nitrogen as ammonium sulfate in the coking process. Petroleum refineries increased their acid consumption 11 percent during 1941, partly because of the augmented call for high-octane aviation gasoline. The tremendous increase in demand for fuming sulfuric acid (oleum), little used except for explosives, was met by erecting auxiliary equipment at existing acid plants. It may be significant that a process has been developed for the continuous nitration of benzene without the use of sulfuric acid.[9]

Chemical and Metallurgical Engineering has estimated the consumption of sulfuric acid, by industries, from 1937 through 1941 as follows:

Sulfuric acid (expressed as 50° B.) consumed in the United States, 1937–41, by industries, in short tons

Industry	1937	1938	1939	1940	1941
Fertilizer	2,230,000	1,900,000	1,970,000	2,260,000	2,500,000
Petroleum refining	1,100,000	1,100,000	1,210,000	1,260,000	1,400,000
Chemicals	1,020,000	800,000	975,000	1,120,000	[1] 1,790,000
Coal products	865,000	585,000	740,000	900,000	940,000
Iron and steel	1,100,000	590,000	980,000	1,200,000	1,450,000
Other metallurgical	625,000	350,000	570,000	640,000	800,000
Paints and pigments	525,000	430,000	520,000	580,000	700,000
Explosives	180,000	140,000	160,000	170,000	[1] 190,000
Rayon and cellulose film	380,000	320,000	405,000	470,000	555,000
Textiles	112,000	90,000	116,000	125,000	165,000
Miscellaneous	450,000	355,000	384,000	460,000	550,000
	8,587,000	6,660,000	8,030,000	9,185,000	11,040,000

[1] To avoid disclosing estimated consumption of acid in direct defense applications, such as military explosives, acid so used in 1941 is included under "Chemicals."

A nonelectrolytic method of producing chlorine from common salt and sulfur was announced in 1941.[10] The manufacture of sulfur pipe for corrosive liquids was described by Bencowitz.[11] A pictorial flow sheet of the production of sulfite pulp was published.[12]

FOREIGN TRADE

Sulfur imports in the first 9 months of 1941 were 20,954 long tons, including 20,937 tons from Canada, 16 tons from the United Kingdom, and 1 ton from Japan. The Canadian material is elemental sulfur

[7] Chemical and Metallurgical Engineering, Sulfuric Acid and Sulfur: Vol. 49, No. 2, February 1942, pp. 82–84, 105.
[8] American Fertilizer, vol. 96, No. 1, January 3, 1942, pp. 10–11.
[9] Chemical and Metallurgical Engineering, vol. 48, No. 11, November 1941, p. 165.
[10] Science News Letter, vol. 40, No. 12, September 20, 1941, p. 183.
[11] Bencowitz, I., Manufacturing Sulfur Pipe: Pit and Quarry, vol. 33, No. 12, June 1941, pp. 72–74.
[12] Chemical and Metallurgical Engineering, vol. 48, No. 8, August 1941, pp. 106–109.

recovered from smelter gases. Imports of sulfuric acid in the same period totaled 2,292 short tons—74 percent from Canada and the remainder from Mexico.

Distribution of exports in 1941 by countries of destination is not available for publication; figures for 1939 and 1940 are shown in the preceding chapter of this series. Exports of sulfuric acid in the first 9 months of 1941 totaled 9,937 short tons; 42 percent was oleum. The materials allocated to Latin America by the Office of Production Management for the first 3 months of 1942 included 1,000 tons of sulfuric acid.

Sulfur imported into and exported from the United States, 1937–41

Year	Imports				Exports			
	Ore		In any form, n. e. s.		Crude		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1937	398	$4,724	230	$38,171	675,297	$12,155,253	13,533	$509,133
1938	51	562	2,552	71,903	579,107	10,378,991	12,707	469,773
1939	35	445	13,941	250,422	627,819	10,771,751	25,005	909,974
1940	([1])	5	27,845	473,052	746,468	13,041,911	19,745	780,968
1941 (Jan.–Sept.)			20,954	335,359	474,551	8,098,958	24,683	994,390

[1] Less than 1 ton.

WORLD PRODUCTION

World production of sulfur in 1940, including elemental sulfur recovered in the treatment of pyrites and as a byproduct from the treatment of industrial gases, is estimated at 3,600,000 long tons.

World production of native sulfur, 1936–41, by countries, in long tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1936	1937	1938	1939	1940	1941
Bolivia (exports)	935	1,712	1,632	2,126	4,065	2,315
Chile [2]	25,525	16,766	20,959	26,999	28,997	24,784
Ecuador	59	54	68	72	([3])	([3])
France (content of ore)	123	157	140	([3])	([3])	([3])
Greece	150	67	75	([3])	([3])	([3])
Guatemala	16	11	15	12	11	([3])
Italy (crude) [4]	322,396	338,101	374,339	([3])	([3])	([3])
Japan	195,107	138,283	([3])	([3])	([3])	([3])
Mexico	[5] 1,272	([3])	49	([3])	([3])	([3])
Netherlands East Indies	11,311	12,474	15,986	17,293	16,908	([3])
Palestine	79	494	1,196	829	1,248	([3])
Peru	1,696	1,551	1,944	569	610	923
Spain [6]	17,742	27,151	26,153	([3])	([3])	([3])
Taiwan	1,207	([3])	([3])	([3])	([3])	([3])
Turkey	3,139	2,229	3,684	2,560	([3])	([3])
United States	2,016,338	2,741,970	2,393,408	2,090,979	2,732,088	3,139,253

[1] Native sulfur is believed to be produced also in Argentina, China, Cuba, India, Iran, and U. S. S. R., but the quantity is unknown.
[2] In addition, the following quantities of sulfur rock (40–80 percent sulfur) are reported: 1936, 11,612 tons; 1937, 1,050 tons.
[3] Data not available.
[4] In addition, the following quantities of sulfur rock are reported: 1936, 20,743 tons; 1937, 19,793 tons; 1938, 16,545 tons. Similar data are not available for later years.
[5] Crude sulfur.
[6] Refined sulfur, exclusive of that made from imported crude sulfur.

Australia.—Production of elemental sulfur from byproduct pyrites is being considered.

Bolivia.—Most of the current exports go to Argentina. A deposit at Napa, Department of Potosi, is reported to contain 5,000,000 tons of material averaging 65 percent sulfur.

Canada.—Elemental sulfur is produced from base-metal smelter gases at Trail, British Columbia, and the feasibility of a similar operation at Montreal East, Quebec, is to be tested by a pilot plant now under construction. Canada exported 20,937 long tons of this byproduct sulfur to the United States in the first 9 months of 1941. The Aldermac project for the production of elemental sulfur from pyrites is still a possibility. Sulfuric acid is manufactured from smelter gases at Trail, British Columbia, and Copper Cliff, Ontario. Seven acid plants manufactured a total of 283,618 metric tons of sulfuric acid (66° B. basis) in 1940.[13]

Chile.—Exports of sulfur totaled 21,371 long tons in 1941 compared with 27,637 tons in 1940. A subsidy has been granted to a Chilean company that will supply 300 long tons of refined sulfur monthly from a deposit in the Province of Arica.[14]

China.—Production of sulfur in Unoccupied China is estimated at 3,540 long tons in 1940.

Costa Rica.—Five deposits in the foothills of volcanoes in the Province of Guanacaste are said to analyze 85 to 95 percent sulfur.

Cuba.—An apparently small underwater sulfur deposit is being worked near Punto Carabela Chica, Province of Pinar del Rio.

Germany.—The Reich has access to large supplies of sulfur from Italy. Furthermore, production of elemental sulfur has been increased by new processes for recovering sulfur from coke-oven and coal-distillation gases at very low concentrations. German sulfuric acid output was reported at 2,800,000 metric tons in 1939.[15]

India, British.—Sulfur operations in the vicinity of the volcanic mountain of Koh-i-Sultan, near Nok Kundi, Baluchistan, were reported to have begun in 1941 with an expected output, for at least a short time, of 60,000 long tons of crude ore annually.

Iran.—Sulfur production in 1939 was reported at approximately 1,000 long tons.

Japan.—The Matsuo mine, Province of Rikuchu, which normally supplies about 25 percent of Japan's sulfur output and which was wrecked by a fire in November 1939, was still idle during most of 1941 but was expected to be in operation again by the beginning of 1942. Sulfur was put under allocation on June 1, 1941, by the Japan Sulfur Control Association. Owing to a shortage of power and to insufficient sulfur supplies, the 1940 production of sulfuric acid is said to have declined to 70 percent of capacity, carbon bisulfide to 43 percent, sodium sulfide to 65 percent, and ammonium sulfate to 79 percent. Plans were instituted in 1941 to raise Japanese sulfuric acid production to 4,000,000 metric tons annually, which would represent a substantial advance over the 1938 output of approximately 2,800,000 tons. The contact process, according to Chemical Age,[16] represented 30 percent of the sulfuric acid capacity in 1939. Exports during the first 9

[13] Canadian Chemistry and Process Industries, vol. 25, No. 5, May 1941, p. 223.
[14] American Chemical Society, News Edition: Vol. 19, No. 24, December 25, 1941, p. 1477.
[15] Chemical and Metallurgical Engineering, vol. 49, No. 1, January 1942, pp. 81 and 159.
[16] Chemical Age, vol. 44, No. 1129, February 15, 1941, p. 100.

months of 1940 included 120 long tons of sulfur and 132 metric tons of sulfuric acid.

Mexico.[17]—A plant has been completed for refining sulfur mined in the State of San Luis Potosi. Sulfuric acid is produced from smelter gases in northern Coahuila.

Norway.—Elemental sulfur is produced from pyrites at the Thamshavn plant of the Orkla Metal Co. An agreement to ship part of the output to Sweden during 1941 was extended to cover 1942.

Portugal.—Production of elemental sulfur from pyrites totaled 9,915 long tons in 1940.

Sweden.—Elemental sulfur is produced from smelter gases at Ronskar, northern Sweden, by the Boliden Co.

United Kingdom.—Control of Sulfuric Acid (No. 2) Order, 1940, Direction 3, effective May 9, 1941, fixed the base price at 27s. a ton for 77-percent acid and 34s. 4d. for 98-percent acid.

PYRITES

DOMESTIC PRODUCTION

Pyrites production in the United States in 1941 exceeded that in 1940 by 5 percent and reached a new record. Ninety-five percent of the output was fines and the remainder lump, the former being principally flotation concentrates.

Pyrites (ores and concentrates) produced in the United States, 1937–41

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1937	584,166	39.7	$1,777,787	1940 [1]	626,640	41.8	$1,920,000
1938	555,629	39.4	1,685,766	1941	659,498	41.8	2,035,000
1939 [1]	519,497	42.3	1,560,000				

[1] Revised figures.

Producers consumed 443,983 long tons and sold 207,504 tons in 1941 compared with revised figures of 422,545 and 206,867 tons, respectively, in 1940. Domestic pyrites mined in 1941 had an average sulfur content of 42 percent and an average value of $3.09 a long ton, f. o. b. mines. Spanish pyrites, minimum 48 percent sulfur, continued to be quoted nominally at 12 cents per long-ton unit of sulfur, c. i. f. U. S. ports, throughout 1941.

THE INDUSTRY IN 1941 BY STATES

California.—The Mountain Copper Co. was the only producer of pyrites in California in 1941; output came from the Hornet mine in Shasta County.

Colorado.—The output of pyrites in Colorado in 1941 totaled 11,774 long tons and was produced by Minnesota Mines, Inc., Clear Creek County, and by John Andrew from a mill tailings dump in Lake County.

[17] Chemical and Engineering News, vol. 20, No. 4, February 25, 1942, p. 281.

Illinois.—From its coal-cleaning operations at the Atkinson mine in Henry County the Midland Electric Coal Corporation produced and shipped 12,026 long tons of pyrites (coal brasses) containing 46 percent sulfur in 1941.

Indiana.—The Snow Hill Coal Corporation produced pyrites (coal brasses) at its Talleydale mine in Vigo County in 1941.

Kansas.—The Mineral Products Co. produced 3,902 long tons of pyrites (coal brasses) containing 44 percent sulfur at West Mineral, Cherokee County, in 1941.

Missouri.—No pyrites production was reported from Missouri in 1941.

Montana.—The pyrites produced in Montana in 1941 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in copper operations.

New York.—In 1941 New York produced 63,958 long tons of pyrites containing 49 percent sulfur.

Pennsylvania.—Pyrites concentrates were produced in 1941 by the Bethlehem Steel Co. at the Cornwall mine, Lebanon County.

Tennessee.—The output of the Tennessee Copper Co., Ducktown Basin, Polk County, enabled Tennessee to retain its rank as the principal producer of pyrites in 1941. The product, a flotation concentrate, does not enter the market but is consumed by the company in the manufacture of sulfuric acid.

Virginia.—The General Chemical Co. has been obtaining the only pyrites mined in Virginia in recent years from the Gossan mine at Cliffview, Carroll County. The output is concentrated by air tables for the manufacture of sulfuric acid in the company plant at Pulaski.

Wisconsin.—The one company reporting production of pyrites in Wisconsin in 1941 was the Vinegar Hill Zinc Co., which recovers pyrites by flotation from ores mined in the Platteville district, Grant County.

FOREIGN TRADE

Imports of pyrites, by countries of origin, in recent years are shown in the following table. Spanish shipments, normally the principal foreign source, dwindled to 21 percent of the imports in the first three quarters of 1941, while Canada supplied virtually all the rest.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1937–41, by countries

Country	1937		1938		1939		1940		1941 (Jan.-Sept.)	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	20,558	$74,946	30,064	$135,659	176,804	$470,336	81,157	$560,476	177,030	$855,533
Greece					22,800	106,271				
Mexico	549	1,473	202	522			203	719	125	525
Portugal	21,725	109,395								
Spain	481,598	1,158,671	303,968	709,983	282,732	738,439	325,644	790,172	47,109	122,671
	524,430	1,344,485	334,234	846,164	482,336	1,315,046	407,004	1,351,367	224,264	978,729

In keeping with the changing source of imported pyrites, shipments to Philadelphia, New York, and Baltimore slumped heavily in the first 9 months of 1941, and those to Buffalo more than doubled.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1937–41, by customs districts, in long tons

Customs district	1937	1938	1939	1940	1941 (Jan.–Sept.)
Buffalo	584	5,130	21,940	80,076	168,984
Georgia	4,795				
Maryland	220,430	113,838	176,982	19,702	9,800
Michigan					5,963
New York	64,621	55,830	46,170	82,292	317
Ohio			2,000		
Philadelphia	194,680	130,703	189,727	215,373	31,118
San Diego	549	202		208	125
South Carolina	9,519	5,265	4,396		
Vermont	19,974	15,713	31,433	937	1,764
Virginia	9,278	7,553	8,885	8,331	6,191
Washington			803	90	2
	524,430	334,234	482,336	407,004	224,264

WORLD PRODUCTION

Recent figures on the pyrites output of many of the countries are not obtainable, but annual world production has been approximating 10,000,000 metric tons containing about 4,300,000 tons of sulfur.

World production of pyrites (including cupreous pyrites), 1938–40, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938		1939		1940	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria	44,150	19,430	(2)	(2)	(2)	(2)
Australia: Tasmania	51,084	(2)	55,099	(2)	(2)	(2)
Belgium	(2)	(2)	29,210	(2)	(2)	(2)
Canada	40,464	20,300	206,507	103,826	(2)	(2)
Cyprus (exports)	523,574	256,551	403,935	(2)	114,831	(2)
Finland	102,979	44,281	(2)	(2)	(2)	(2)
France	147,208	65,655	(2)	(2)	(2)	(2)
Germany	465,267	200,064	(2)	(2)	(2)	(2)
Greece	244,000	118,605	217,200	98,826	(2)	(2)
Italy	930,312	386,079	(2)	(2)	(2)	(2)
Norway	1,027,776	446,939	1,024,953	445,431	(2)	(2)
Poland	92,209	36,883	(2)	(2)	(2)	(2)
Portugal	558,327	251,247	(2)	(2)	(2)	(2)
Rumania	11,205	7,061	5,869	(2)	(2)	(2)
Southern Rhodesia	27,065	10,900	27,386	(2)	(2)	(2)
Spain [3]	2,727,003	[4] 1,145,341	[4] 2,600,000	[4] 1,092,000	(2)	(2)
Sweden	186,390	84,345	191,737	87,342	(2)	(2)
Union of South Africa	31,017	13,947	29,825	13,389	36,701	16,248
United Kingdom	4,351	(2)	(2)	(2)	(2)	(2)
United States	564,547	222,612	[5] 527,835	[5] 223,097	[5] 636,698	[5] 266,191
Uruguay	70	(2)	(2)	(2)	(2)	(2)
Yugoslavia	150,402	67,681	127,991	57,596	[4] 146,388	[4] 65,875

[1] In addition to countries listed, Brazil, China, Chosen, Czechoslovakia, Eire, India, Japan, and U. S. S. R. produced pyrites, but production data are not available.
[2] Data not available.
[3] Production data (gross weight) not heretofore available for 1936 and 1937 are 1,739,793 and 2,277,428 tons, respectively. Average sulfur content of Spanish pyrites was 42 percent in 1931, the latest year for which such information is available.
[4] Estimated.
[5] Revised figures.

Australia.—The copper mines at Mount Lyell, Tasmania, have a daily output of 145 metric tons of pyrites concentrates containing 51 percent sulfur.[18] Proposals for expansion of Australian pyrites production are being considered.

Brazil.—A mine at Rio Claro, State of Rio de Janeiro, has a daily output of 2 metric tons of pyrites averaging 43 percent sulfur. Production of pyrites in Parana and also as a byproduct of coal mining is contemplated.

Canada.—Pyrites concentrates are produced as an accessory to copper at the Aldermac and Noranda mines in Quebec and the Britannia mine in British Columbia. Output from Delestre Township, Quebec, is anticipated in 1942. Noranda Mines, Ltd., is now recovering essentially all of its pyrites concentrates, and drier equipment ordered in 1941 was expected to increase the capacity to about 450 metric tons daily.[19] Canada exported 179,871 metric tons of pyrites to the United States during the first 9 months of 1941. A second paper mill in the Dominion has turned from imported sulfur to Canadian pyrites as a source of sulfur dioxide. Thousands of tons of pyrites cinder containing about 50 percent iron were shipped in 1941 from Ontario to the Republic Steel Corporation plant at Buffalo, N. Y.

Cyprus.—Production declined approximately 50 percent to 257,000 metric tons in 1940 and virtually ceased in 1941. Exports during the first 5 months of 1941 were only about 5,000 metric tons.

Czechoslovakia.—Production of iron pyrites in the Province of Slovakia, according to the German press, was 11,000 metric tons in 1941 and 14,000 tons in 1940 compared with 10,000 tons in 1939 and 18,000 tons in 1937.[20]

Eire.—Iron pyrites mining has begun in County Wicklow for production of sulfuric acid for fertilizer manufacture.

India, British.—Some pyrites is mined near Simla. A growing demand for sulfuric acid and the success of a pilot-plant extraction of elemental sulfur from pyrites may stimulate larger-scale exploitation of Indian pyrites.[21]

Norway.—New pyrites deposits were reported discovered in Norway in 1941. Sulfur and pyrites valued at 5,000,000 kroner (about $1,200,000) are to be exported to Sweden in 1942 in continuation of a previous trade agreement.

Portugal.—Production of pyrites was 372,506 metric tons in 1940 compared with 502,311 tons in 1939.[22] Exports were 179,423 tons in 1940 and 436,048 tons in 1939, going principally to France, the United Kingdom, and Belgium.

Spain.—Spanish pyrites production during the first 10 months of 1941 was 381,778 metric tons.[23] Water-borne shipments in 1940 were unofficially reported as 957,716 tons. The sharp decline in output is attributed primarily to limitations on available cargo space but also to lack of dynamite, coal, and equipment and loss of Continental markets. The Ministry of Industry in 1941 issued a decree, effective

[18] Mining Magazine (London), vol. 64, No. 3, March 1941, p. 155.
[19] Canadian Mining Journal, vol. 62, No. 9, September 1941, p. 662.
[20] Metal Bulletin (London), No. 2680, March 27, 1942, p. 4.
[21] Chemical Age (London), vol. 46, No. 1176, January 10, 1942, p. 33.
[22] Mining Journal (London), vol. 213, No. 5527, July 26, 1941, p. 353.
[23] Metal Bulletin (London), No. 2681, March 31, 1942, p. 6.

toward the end of the year, ordering cupriferous pyrites to be roasted within the country to recover the copper for the manufacture of copper sulfate. A plant is being built at Valencia for yearly extraction of 2,250 metric tons of copper, 71,500 tons of iron, and 3,750 tons of sodium sulfate from cupriferous pyrites.[24] Of the current Spanish pyrites output, about one-third is going to the United States and an occasional cargo to England; the bulk of the remainder is consumed domestically.[25] Despite rumors to the contrary, apparently little or none is reaching Germany.

Sweden.—Test drillings have revealed new deposits of cupriferous pyrites in the Kuorbevaro district, Department of Västerbotten.

Union of South Africa.—Production was 16,118 metric tons in the first half of 1941 compared with 18,858 tons in the corresponding period of 1940.

United Kingdom.—Marcasite is produced as a byproduct in coal mining.

Yugoslavia.—Trepca Mines, Ltd., reported that, in the 4 months from November 1940 to February 1941, 247,291 metric tons of ore were milled, yielding 16,971 tons of pyrites in addition to lead, zinc, and copper concentrates.[26] The mines were undamaged when the Germans took them over in April 1941, but a shortage of workers is said to have hindered subsequent operations to some extent.

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[24] Mining Journal (London), vol. 216, No. 5557, February 21, 1942, p. 95.
[25] Chemical and Metallurgical Engineering, vol. 49, No. 3, March 1942, p. 122.
[26] Metal Bulletin (London), No. 2654, December 23, 1941, p. 6.

PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

GENERAL CONDITIONS

Never before was so much domestic phosphate rock marketed in a single year as in 1941. The quantity sold or used by producers exceeded the 4,103,982 long tons sold or used during the abnormal post-war boom year 1920 by over one-half million tons (see fig. 1). Shipments of phosphate rock from American mines in 1941 totaled 4,668,312 long tons [1] valued at $15,587,738, an increase over 1940 of nearly 700, 000 tons (17 percent) and of 3½ million dollars (26 percent). Mined production in 1941—4, 920, 843 tons, 21 percent above the 1940 figures—likewise broke all previous records. Exports for the first 9 months of the year, the only period for which figures can be published, were much greater (9 percent in quantity and 20 percent in value) than for all 12 months of 1940. No imports of phosphate rock or apatite were recorded in 1941.

Reports published in 1941 covering the phosphate-rock industry in general include papers by Jacob, McCord, Logue, and the Bureau of the Census.[2]

General scientific papers published include those by Mansfield,[3] Tremearne and Jacob,[4] Jacob and Ross,[5] Frondel,[6] Fahey and Tunell,[7] and Rader and Hill.[8]

[1] In addition to this tonnage, a small quantity of phosphate rock was mined and sold in Utah during 1941. The Bureau of Mines is not at liberty to publish the Utah output separately; therefore, it is not included in any of the figures in this chapter.

[2] Jacob, K. D., Phosphate Rock [in 1940]: Mineral Ind., vol. 49, 1941, pp. 473–491.
McCord, M. H., Problems Confronting Phosphate Producers: Nat. Fertilizer Assoc., Proc. 17th Ann. Convention, White Sulphur Springs, W. Va., June 9–11, 1941, pp. 17–20.
Logue, Paul, The Family of Phosphates: Chem. Ind., part I, vol. 49, No. 3, September 1941, pp. 302–305; part II, vol. 49, No. 4, October 1941, pp. 456–459.
U. S. Department of Commerce, Bureau of the Census, Phosphate Rock: 16th Census of the United States, 1940, Mineral Industries, 1939 (Preliminary), Washington, D. C., July 1941, 5 pp.

[3] Mansfield, G. R., Phosphate Deposits of the World, with Special Reference to those of the United States: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 9–12.

[4] Tremearne, T. H., and Jacob, K. D., Arsenic in Natural Phosphates and Phosphate Fertilizers: U. S. Dept. of Agriculture Tech. Bull. 781, November 1941, 39 pp.

[5] Jacob, K. D., and Ross, W. H., Nutrient Value of the Phosphorus in Defluorinated Phosphate, Calcium Metaphosphate, and Other Phosphatic Materials as Determined by Growth of Plants in Pot Experiments: Jour. Agric. Research, vol. 61, No. 7, October 1, 1940, pp. 539–560.

[6] Frondel, Clifford, Whitlockite—a New Calcium Phosphate: Am. Mineral., vol. 26, 1941, pp. 145–152.

[7] Fahey, Joseph J., with an X-ray analysis by Tunell, George, Bradleyite, a New Mineral, Sodium Phosphate Magnesium Carbonate: Am. Mineral., vol. 26, 1941, pp. 646–650.

[8] Rader, L. F., Jr., and Hill, W. L., Determination and Occurrence of Boron in Natural Phosphates, Superphosphates, and Defluorinated Phosphate Rocks: Jour. Agric. Research, vol. 57, No. 12, December 15, 1938, pp. 901–916.

Salient statistics of the phosphate-rock industry in the United States, 1940–41

	1940			1941		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
Production (mined)	4,068,077	(1)	(1)	4,920,843	(1)	(1)
Sold or used by producers:						
Florida:						
Land pebble	[2] 2,780,800	[2] $7,538,316	[2] $2.71	3,279,706	$9,890,510	$3.02
Soft rock	41,845	102,508	2.45	47,750	132,472	2.77
Hard rock	22,367	100,353	4.49	38,116	211,049	5.54
Total Florida	2,845,012	7,741,177	2.72	3,365,572	10,234,031	3.04
Tennessee [2,3]	994,361	3,967,043	3.99	1,120,358	4,590,965	4.10
Idaho	99,088	441,598	4.46	97,274	444,154	4.57
Montana	64,239	184,844	2.88	105,108	318,588	3.03
Virginia [3]	(3)	(3)	(3)	(3)	(3)	(3)
Total United States	4,002,700	12,334,662	3.08	4,688,312	15,587,738	3.32
Imports [4]	2,953	19,536	6.62	---	---	---
Exports [5,6]	751,495	3,845,495	5.12	[7] 820,396	[7] 4,606,449	[7] 5.61
Apparent consumption [8]	3,254,158	---	---	(9)	---	---
Stocks in producers' hands, Dec. 31:						
Florida	1,420,000	(1)	(1)	[2] 1,483,000	(1)	(1)
Tennessee [3,10]	268,000	(1)	(1)	292,000	(1)	(1)
Other	3,000	(1)	(1)	3,000	(1)	(1)
Total stocks	1,691,000	(1)	(1)	1,778,000	(1)	(1)

1 Figures not available. 2 Includes sintered matrix. 3 Virginia included with Tennessee.
4 Market value (or price) at port and time of exportation to the United States.
5 1940: Excludes sintered matrix, which is included under "Other phosphate materials"; 1941: Includes sintered matrix.
6 Value at port of exportation.
7 Figures cover January to September, inclusive.
8 Quantity sold or used by producers plus imports minus exports.
9 Figures not available for publication.
10 Includes brown-rock matrix of sinter grade and sintered brown rock.

PRODUCTION

Phosphate rock was mined in 1941 in Florida, Tennessee, Idaho, Montana, and Utah, and apatite was recovered from apatite-ilmenite ore in central Virginia. Total mine production reached about 5 million tons (4,920,843 long tons), nearly two-thirds of a million tons more than the previous all-time record of 4,261,416 tons reached in 1937. Production increased in Florida, Tennessee, and the Western States, and the mined production in each attained an all-time high.

Phosphate rock mined in the United States, 1932-41, by States, in long tons

Year	Florida	Tennessee [1]	Western States	United States	Year	Florida	Tennessee [1]	Western States	United States
1932	1,500,891	152,533	44,724	1,698,148	1937	3,179,588	942,158	139,670	4,261,416
1933	2,039,531	296,441	23,663	2,359,635	1938	2,722,927	[2] 999,551	137,998	3,860,476
1934	2,464,969	394,311	38,958	2,898,238	1939	2,791,360	1,057,570	139,040	3,987,970
1935	2,598,337	493,501	67,490	3,159,328	1940	2,782,956	1,120,551	164,570	4,068,077
1936	2,645,819	737,866	79,152	3,462,837	1941	3,417,900	1,301,067	201,876	4,920,843

1 Includes small quantity of apatite from Virginia.
2 Includes also small quantity of phosphate rock from South Carolina.

SALES

The quantity of phosphate rock sold or used by producers in 1941 (4,688,312 long tons) topped that in 1940 by over two-thirds of a million tons (17 percent) and the previous all-time high of 1920 (4,103,982 tons) by more than one-half million tons (see fig. 1). The total value in 1941 was 26 percent greater than the total in 1940; however, it was nearly 10 million dollars less than the 1920 peak, which was caused by the high average value ($6.11) of sales during the 1920 boom. In 1941 the average value of total sales was only $3.32 a ton, slightly higher than in 1940 but still in consonance with the slight downtrend of average values in recent years.

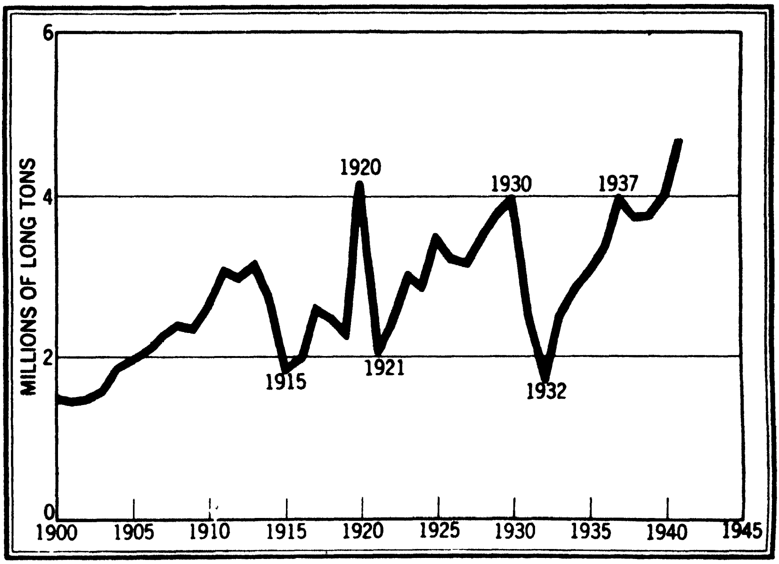

Figure 1.—Marketed production of domestic phosphate rock, 1900–1941.

Phosphate rock sold or used by producers in the United States, 1937–41

Year	Long tons	Value at mines: Total	Value at mines: Average	Year	Long tons	Value at mines: Total	Value at mines: Average
1937	3,956,189	$12,975,268	$3.28	1940	4,002,700	$12,334,662	$3.08
1938	3,739,238	12,952,143	3.46	1941	4,688,312	15,587,738	3.32
1939	3,757,067	12,294,042	3.27				

DISTRIBUTION OF SALES

Shipments of domestic phosphate rock in recent years have fallen largely into two distinct groups according to grade—one below 60 percent B. P. L. (bone phosphate of lime) and the other containing 68 percent B. P. L. and higher grades. In 1941 the gap between these two groups became more distinct; larger quantities of the lower grade, much less of the 60- to 66-percent grade, and considerably less of the

68 basis, 66 minimum grade were sold. Ninety-one percent of the sales of phosphate rock in 1941 were, however, still of the higher grades, mostly between 70 and 77. Only 60 percent of the total sales of domestic phosphate rock sold or used by producers for consumption in the United States appears to have gone into the manufacture of superphosphates, although the quantity so consumed was much larger in 1941 than in 1940. The use of phosphate rock in chemicals and for direct application to soils increased.

The following table, showing distribution of phosphate rock sold or used by producers by grades, uses, and classes of consumers, was compiled from reports to the Bureau of Mines by domestic producing companies.

Phosphate rock sold or used by producers in the United States, 1940–41, by grades, uses, and classes of consumers

	1940			1941		
	Quantity		Value	Quantity		Value
	Long tons	Percent of total		Long tons	Percent of total	
Grades—B. P. L.[1] content (percent):						
Below 60	347,696	9	(2)	428,869	9	(2)
60 to 66	55,359	1	(2)	9,628	(3)	(2)
68 basis, 66 minimum	357,983	9	(2)	232,540	5	(2)
70 minimum	339,744	9	(2)	468,454	9	(2)
72 minimum	1,390,284	35	(2)	1,524,476	32	(2)
75 basis, 74 minimum; 75 minimum	986,309	23	(2)	1,065,272	23	(2)
77 basis, 76 minimum	328,628	8	(2)	607,480	13	(2)
77 minimum				----	----	----
Above 85 (apatite); Undistributed[4]	246,697	6	(2)	411,593	9	(2)
	4,002,700	100	$12,334,662	4,688,312	100	$15,587,738
Uses:						
Domestic:						
Superphosphates	2,564,844	64	(2)	2,825,456	60	(2)
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	532,980	13	(2)	644,948	14	(2)
Direct application to soil	106,292	3	(2)	143,196	3	(2)
Fertilizer filler	32,804	1	(2)	1,074,712	23	(2)
Stock and poultry feed	1,311	(3)	(2)			
Undistributed[5]	6,747	(3)	(2)			
Exports[6]	757,722	19	2,995,591			
	4,002,700	100	12,334,662	4,688,312	100	15,587,738
Classes of consumers:[6]						
Affiliated companies	1,089,045	27	2,961,334	1,134,295	24	3,257,681
Other domestic consumers	2,155,933	54	6,377,737	3,554,017	76	12,330,057
Export	757,722	19	2,995,591			
	4,002,700	100	12,334,662	4,688,312	100	15,587,738

[1] Bone phosphate of lime.
[2] Figures not available.
[3] Less than 0.5 percent.
[4] Includes grades of B. P. L. content between 69 and 72.9, 72–73, 73, 73.8, 74.8, 76, 76.9, and above 85 percent; also ground phosphate rock and dust, B. P. L. content not known.
[5] Includes some calcined phosphate and phosphatic material used in pig iron blast furnaces, in manufacture of concentrated fertilizers, and in minor uses not specified.
[6] As reported to Bureau of Mines by domestic producers.

CONSUMPTION

The annual consumption of phosphate rock in the United States for 1867–1940 (data for 1941 not available for publication) is graphed in the accompanying diagram (fig. 2).

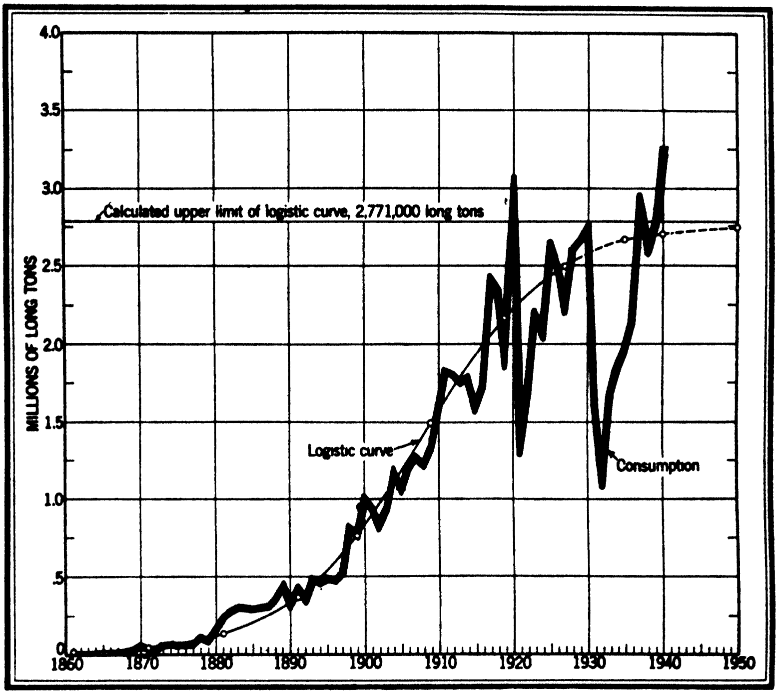

FIGURE 2.—Consumption of phosphate rock in the United States, 1867–1940.

PRICES

Trade-journal (Oil, Paint and Drug Reporter) quotations for the several grades of phosphate rock increased irregularly during the year, changes in one grade or another occurring in March, August, and September. The total advances ranged from 5 to over 38 percent. In December, a new method of stating grades, with lower ranges, was instituted; the prices, however, remained the same as the higher quotations of the period immediately preceding. The various changes in price quotations and grades throughout 1941 are shown in the following table.

The antitrust suit, originally against 102 defendants—2 trade associations, 64 fertilizer companies, and 36 officials of the defendant corporations—charged with violation of the Sherman Act, was terminated March 24, 1942, in the Federal District Court of the Middle District of North Carolina at Winston-Salem. The defendants, except 7 as to whom the case was nolle-prossed, entered pleas of nolo contendere. In lieu of trial, informal hearings were held March 16 to 24, 1942, for the information of the judge. Judgment was rendered March 24, 1942. Fines are reported to have been imposed on 63 corporations and 31 individuals. The indictment contained

two counts, charging price fixing and suppression of competition, and in most instances fines are stated to have been imposed on both counts.[9]

Prices per long ton of Florida and Tennessee phosphate rock, bulk f. o. b. mine, in 1941 [1]

[Leaders indicate that prices are not quoted]

	Jan. 6–Mar. 10	Mar. 17–July 28	Aug. 4–Sept. 15	Sept. 22–Dec. 1	Dec. 8–29
Florida:					
High-grade hard rock:					
Grades—B. P. L.[2] content (percent):					
77-percent basis, 76-percent minimum	$4.35				
76-percent minimum				$5.00	
77–76 percent					$5.00
Land pebble:					
Grades—B. P. L.[2] content (percent):					
68-percent minimum	1.90	$1.90	$2.00	2.00	
70-percent minimum [3]	2.15	[3] 2.15	$2.30–2.40	$2.30–2.40	
72-percent minimum [3]	2.40	[3] 2.50	2.75–3.00	2.75–3.00	
75-percent basis, 74-percent minimum	2.90				
74-percent minimum				4.00	
68–66 percent					2.00
70–68 percent					2.40
72–70 percent					3.00
75–74 percent					4.00
Tennessee:					
Grades—B. P. L.[2] content (percent):					
72 percent	4.50	4.50	4.50	5.00	
75 percent	5.50	5.50	5.50	6.00	
72–70 percent					5.00
75–74 percent					6.00

[1] Weekly quotations of Oil, Paint and Drug Reporter.
[2] Bone phosphate of lime.
[3] During period May 12 to July 14, grade quoted as "70-percent minimum, 72-percent minimum, $2.50."

REVIEW BY STATES

Florida.—Total shipments of phosphate rock from Florida were 18 percent greater in quantity and nearly 2½ million dollars in value in 1941 than in 1940, the average value of the shipments increasing from $2.72 in 1940 to $3.04 in 1941. Land-pebble shipments, which constituted 97 percent of all Florida phosphate-rock sales, likewise showed an 18-percent increase in quantity and more than a 2-million-dollar increase in value; the average value increased from $2.71 to $3.02. Soft-rock and hard-rock sales also increased. Soft-rock sales in 1941 were 14 percent greater in quantity and 29 percent in value than in 1940; hard-rock sales nearly doubled in quantity and more than doubled in value but still were far short of the 1939 figures. The average value reported for hard rock increased from $4.49 a ton in 1940 to $5.54 in 1941, the highest figure for several years. Hard rock-mining operations were conducted jointly by C. and J. Camp and J. Buttgenbach & Co. Operations started in October 1941 in sec. 22, where a preliminary washer feeds to the finishing washer at Felicia, 3 miles from Hernando. Shipments before October were made from stocks at the mines and at Fernandina. The other hard rock-operating company, Dunnellon Phosphate Mining Co., did

[9] Oil, Paint and Drug Reporter, Fertilizer "Trust" Case Settled: Vol. 141, No. 13, March 30, 1942, pp. 3, 54. American Fertilizer, Fertilizer Antitrust Suit Settled: Vol. 96, No. 7, March 28, 1942, p. 10.

no mining in 1941 but shipped hard rock from stocks. The Pembroke Chemical Corporation, Pembroke, reported no shipments of sintered phosphate-rock matrix, but this company as well as the seven usual producers shipped land pebble. Total stocks of Florida phosphate

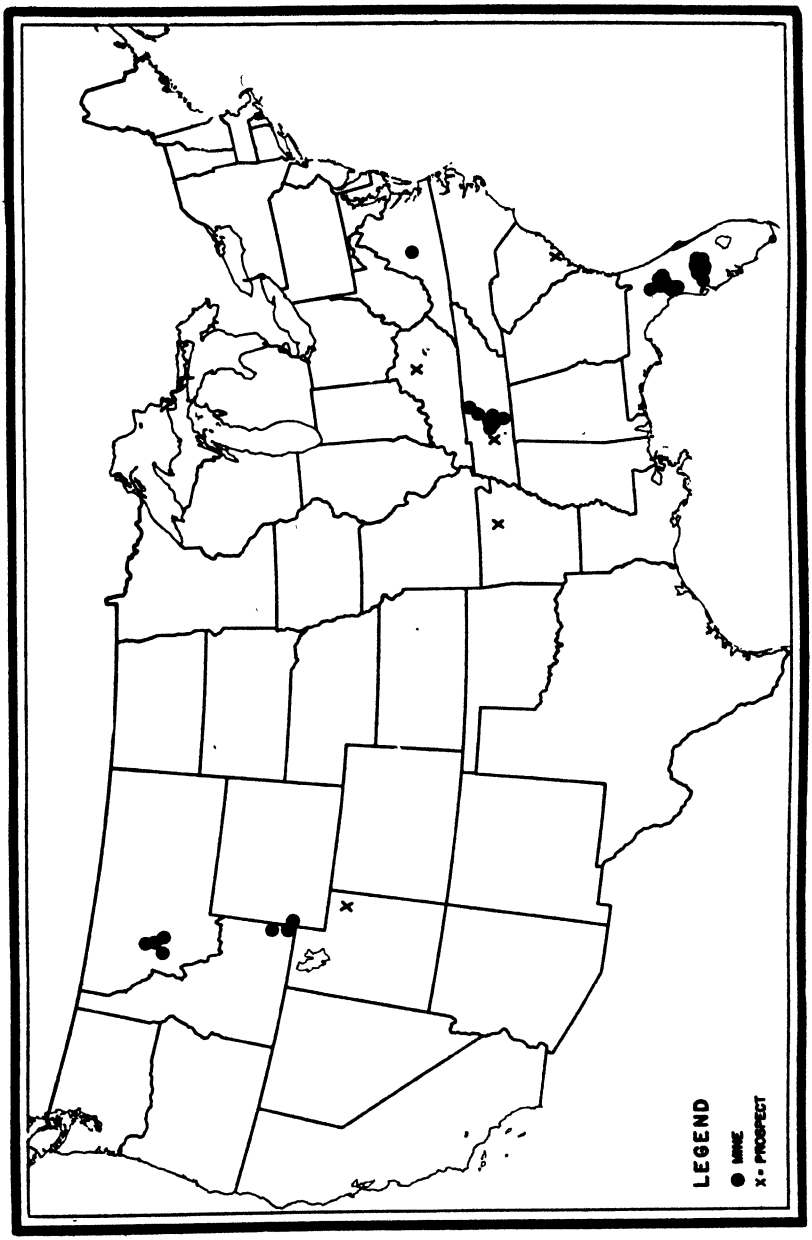

FIGURE 3.—Geographic distribution of phosphate-rock mines and prospects in the United States.

rock in the hands of producers were slighty larger at the end of 1941 than on December 31, 1940, and totaled nearly a million and a half long tons.

Florida phosphate rock sold or used by producers, 1937-41, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1937	64,151	$342,202	$5.33	60,256	$200,271	$3.32
1938	125,048	601,922	4.81	53,479	178,093	3.33
1939	89,096	411,455	4.62	41,906	128,435	3.06
1940	22,367	100,353	4.49	41,845	102,508	2.45
1941	38,116	211,049	5.54	47,750	132,472	2.77

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1937	[2] 2,872,413	[2] $8,600,512	$2.99	[2] 2,996,820	[2] $9,142,985	$3.05
1938	[2] 2,528,808	[2] 7,993,665	3.16	[2] 2,707,335	[2] 8,773,680	3.24
1939	[2] 2,547,782	[2] 7,353,567	2.89	[2] 2,678,784	[2] 7,893,457	2.95
1940	[2] 2,780,800	[2] 7,538,316	2.71	[2] 2,845,012	[2] 7,741,177	2.72
1941	3,279,706	9,890,510	3.02	3,365,572	10,234,031	3.04

[1] Includes material from waste-pond operations.
[2] Includes sintered matrix.

The International Minerals & Chemical Corporation (formerly the International Agricultural Corporation) began operations on a new mine and plant to produce phosphate rock from other portions of its Florida reserves, owing to depletion of areas now being mined near Mulberry.

Cash [10] presents the data on accident experience of the pebble-phosphate industry in Florida for 1939 and 1940.

The Southern Phosphate Corporation in 1941 built an agglomerate tabling plant of 36 Deister-Overstrom tables at its Pauway mine to treat washer tailings from previous mining operations. Jones [11] has prepared a detailed, illustrated description of this plant. Edwards' [12] survey of electrical distribution and power applications at the Southern Phosphate Corporation mines and plants was published late in 1941.

The American Agricultural Chemical Co. is reported to have added dry mixing to its sulfuric acid and superphosphate operations at Pierce in 1941, so that it now has a complete fertilizer plant at that place. Its No. 1 recovery unit at Alderman Station is described in a recent report.[13]

The American Cyanamid Co. is reported to have built a new drying plant with a capacity of 150 tons per hour of wet phosphate rock.

Three papers by Taylor [14] on the land-pebble phosphate-rock deposits of Florida and the operations in that area have appeared in recent months.

[10] Cash, F. E., Accident Experience at Pebble Phosphate Operations in Florida, 1939–40: Bureau of Mines Inf. Circ. 7186, 1941, 15 pp

[11] Jones, Spencer, New Florida Tabling Plant Recovers Phosphate Fines from Tailings Dump: Pit and Quarry, vol. 34, No. 5, November 1941, pp. 43–49

[12] Edwards, J. H., Southern Phosphate's Electric Load Now 6,500 Horsepower: Eng. and Min. Jour., vol. 142, No. 12, December 1941, pp. 51–53.

[13] Pit and Quarry, New Phosphate-Recovery Methods Make Reprocessing of Waste Profitable: Vol. 34, No. 3, September 1941, pp. 57–58.

[14] Taylor, W. H., Land-Pebble Deposits of Florida: Pit and Quarry, vol. 34, No. 1, July 1941, pp. 103–105; No. 4, October 1941, pp. 50–52; No. 10, April 1942, pp. 49–52.

Tennessee.—The tonnage of phosphate rock sold or used by Tennessee producers (plus a small quantity of apatite from Virginia) aggregated 1,120,358 long tons, exceeding the previous all-time high of 1940 by 13 percent and passing 1 million tons for the first time. The total value of shipments exceeded 4½ million dollars. All shipments from Tennessee were brown rock. Total stocks in the hands of producers at the close of 1941 were somewhat larger than on December 31, 1940, being a little over one-quarter million tons in each of the 2 years.

Tennessee phosphate rock (including sintered matrix) sold or used by producers, 1937–41

[Includes apatite from Virginia]

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1937 [1]	825,099	$3,343,108	$4.05	1940	994,361	$3,967,043	$3.99
1938	899,298	3,725,601	4.14	1941	1,120,358	4,590,965	4.10
1939 [1]	938,448	3,856,505	4.11				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.

Late in 1940 Whitlatch [15] presented a paper on the current and past estimates of phosphate reserves in Tennessee; he critically examined the data available and gave supplementary information on Tennessee reserves, repeating the conclusions given in a previous paper (see Minerals Yearbook, 1940, Review of 1939, p. 1309). In concluding this paper he states that—

> The history of reserve estimates clearly indicates the tendency of past investigators to underestimate the phosphate reserves, chiefly because of failure to properly evaluate future technologic advances and trade trends, which have had the effect of amplifying reserves. Although the latest (1938 and 1940) reserve estimates have endeavored to recognize such factors and have, in consequence, established record-breaking figures, the writer must conclude that probably within 10 to 25 years even these figures will be obsolete. Phosphate mining undoubtedly will continue in Tennessee long after the exhaustion of grades now included in reserve tonnages, and as these grades are exhausted, new means of recovery for still lower grades will be devised, and reserve estimates will be accordingly amplified.

Six private companies continued to supply by far the major part of the phosphate rock produced in Tennessee—the Armour Fertilizer Works, Charleston Mining Co., Federal Chemical Co., Hoover & Mason Phosphate Co., International Minerals & Chemical Corporation (formerly the International Agricultural Corporation), and Monsanto Chemical Co. Few changes have been reported in their operations. The Hoover & Mason Phosphate Co., however, made radical changes in the intake end of its washing plant by removing the high towers and blast-furnace skips ahead of the washing and drying plants. Both have been replaced by belt conveyors from ground storage. The grinding- and bagging-plant capacity was also increased.

The phosphate-rock matrix-nodulizing plant completed at the Mount Pleasant (Tenn.) plant of the Charleston Mining Co. in 1938,

[15] Whitlatch, G. I., Current and Past Estimates of Phosphate Reserves in Tennessee: Jour. Tennessee Acad. Science, vol. 16, No. 4, 1941, pp. 310–325.

with added improvements in 1939 and 1940, is described in a recent illustrated article by Nordberg.[16]

The International Minerals & Chemical Corporation operations in the Tennessee brown-rock phosphate fields are described in an article published early in 1942.[17]

According to the Annual Report of the Tennessee Valley Authority, studies during the fiscal year 1941 were directed toward improving several steps in the large-scale processes for manufacturing concentrated superphosphate and calcium metaphosphate. Further work was done, on a pilot-plant scale, in developing the blast-furnace process for producing phosphoric acid. Successful operation of a pilot plant was attained for the production of fused rock phosphate fertilizer of low fluorine content, and preliminary work was begun on the development of a process for producing fertilizer by fusing rock phosphate with olivine. Small-scale studies of various processes for manufacturing dicalcium phosphate fertilizer were initiated. As in previous years, the large-scale experimental fertilizer plant was employed to produce superphosphate and calcium metaphosphate. Part of the superphosphate was sold to the Agricultural Adjustment Corporation; the remainder, as well as all the calcium metaphosphate, was used in tests and farm demonstrations. Although operation of the plant was curtailed in the later months of the year to make additional power available for defense industries, production was greater than in the previous year. Several thousand tons of elemental phosphorus from the Muscle Shoals plant have gone into the manufacture of war materials. This plant is now being adapted so that almost its full capacity may be used for producing elemental phosphorus.

In Tennessee, construction work was under way during the year by T. V. A. at several localities, including a mining and washing plant in the Bear Creek area for the recovery and treatment of phosphate rock from the Authority's own deposits and a sintering unit at Godwin, near Columbia, for preparing material to be shipped to Muscle Shoals, Ala.

Virginia.—The Southern Mineral Products Corporation, subsidiary of the Vanadium Corporation of America, operated its open-cut mine on a body of apatite-bearing titanium ore (nelsonite) at Piney River and treated the mined material in its nearby mill to separate and recover apatite and ilmenite.

The occurrence and origin of the titanium-bearing deposits of Nelson and Amherst Counties have been described in detail by Ross.[18]

Sawyer and Whittemore[19] discuss the utilization of apatite from Virginia in the preparation of refractories; Whittemore,[20] in a short accompanying paper, considers the ceramic possibilities of apatite from that State. He points out that in the manufacture of a suitable aggregate or grog from Virginia kyanite for the refractories industries a "small addition of apatite was a very effective flux and mineralizer with aluminosilicates." An analysis of the fluorapatite from Piney River is given in the article.

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[16] Nordberg, Bror, Nodulizing Phosphate in Kilns: Rock Products, vol. 44, No. 9, September 1941, pp 37–40, 46..

[17] Excavating Engineer, Mining Phosphate in Tennessee: Vol. 36, No. 4, April 1942, pp. 190–193, 198.

[18] Ross, C. S., Occurrence and Origin of the Titanium Deposits of Nelson and Amherst Counties, Va.: Geol. Survey Prof. Paper 198, 1941, 59 pp.

[19] Sawyer, J. P., Jr., and Whittemore, J. W., The Development of a Refractory Aggregate from Virginia Kyanite: Virginia Poly. Inst., vol. 35, No. 2, November 1941, pp. 5–36.

[20] Whittemore, J. W., Ceramic Possibilities for Virginia Apatite: Virginia Poly. Inst., vol. 35, No. 2, November 1941, p. 37.

Western States.—In 1941, Idaho, Montana, and Utah were the only Western States that produced phosphate rock. In Idaho the Anaconda Copper Mining Co. operated its No. 3 mine at Conda, Caribou County. Montana had two producers. The larger of these—the Montana Phosphate Products Co., of Trail, British Columbia—operated the Anderson and Graveley mines and Federal Government leases, shipping the mined phosphate rock to the Consolidated Mining & Smelting Co. of Canada, at Trail. The other producer—the Mineral Hill Mining Co.—operated its mine near Avon, Powell County, and shipped the crude phosphate rock to the Anaconda Copper Mining Co. at Anaconda. In Utah John M. Uren and the Garfield Chemical & Mfg. Co. mined and shipped phosphate rock from Government-leased land near Spanish Fork, Utah County.

Early in 1942, the Teton Phosphate Co., Boise, Idaho, began to ship phosphate rock from its holdings near Montpelier, Idaho.

The plant of the Anderson Phosphate Co. near Garrison, Mont., is reported to have been destroyed by fire late in 1941.

Idaho phosphate rock carries a small percentage of vanadium oxide; this material, needed for special steel alloys for war purposes, is recovered from these ores by the Anaconda Copper Mining Co. as a byproduct of its treatment of the phosphate rock from Conda.

In a recent report Richardson[21] describes the geology of a phosphate area in the Randolph quadrangle which covers northeastern Utah and southwestern Wyoming. Small amounts of phosphate rock formerly were mined in this region.

On November 12, 1941, Secretary of the Interior Harold L. Ickes announced the formation of a consulting committee which, it is reported, will investigate the possibilities of the production of low-cost fertilizer and its distribution to the farmers of the Northwest.

Western States phosphate rock sold or used by producers, 1937–41

Year	Idaho			Montana			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1937	83,436	$356,037	$4.27	50,834	$133,138	$2.62	134,270	$489,175	$3.64
1938	66,014	296,595	4.49	66,491	155,917	2.34	132,505	452,512	3.42
1939	95,451	431,938	4.53	44,384	112,142	2.53	139,835	544,080	3.89
1940	99,088	441,598	4.46	64,239	184,844	2.88	163,327	626,442	3.84
1941	97,274	444,154	4.57	105,108	318,588	3.03	202,382	762,742	3.77

FOREIGN TRADE[22]

Imports.—Total imports of phosphate rock declined gradually from 13,400 long tons in 1937 to 2,953 tons in 1940. Because of war restrictions, data on imports in 1941 are available for publication for the first 9 months only; during this period neither phosphate rock nor apatite was imported. Imports of ammonium phosphates used as fertilizer declined sharply in 1941, only 4,858 long tons entering the

[21] Richardson, G. B., Geology and Mineral Resources of the Randolph Quadrangle, Utah-Wyoming: Geol. Survey Bull. 923, 1941, 54 pp.
[22] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

United States from January to September. In the same period no basic slag was imported. Imports of guano from January to September 1941 increased greatly and totaled 14,752 long tons, or more than in any full year since 1938.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1937–41

Fertilizer	1937		1938		1939		1940		1941 (Jan.-Sept.)	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite			2	$5						
Phosphates, crude, not elsewhere specified	13,400	$115,926	7,004	80,534	3,500	$23,625	2,953	$19,536		
Ammonium phosphates, used as fertilizer	27,253	1,089,657	29,028	1,286,935	34,995	1,627,608	44,782	1,959,900	4,858	$203,344
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	37,341	857,349	19,581	393,808	40,530	799,179	27,676	618,538	20,418	449,497
Guano	13,104	375,650	15,199	717,817	5,151	211,941	785	17,164	14,752	442,406
Slag, basic, ground or unground	714	7,339	691	9,547	405	5,168	452	4,766		
Precipitated bone, fertilizer grade	4,414	120,225	3,385	98,725	2,314	68,611	1,141	38,225		

Exports.—Because of wartime restrictions on release of foreign trade data for 1941, the total quantity and value of exports from January to September only can be published; exports by countries of destination cannot be published. Exports of phosphate rock were much larger in these 9 months than in the whole 12 months of 1940. Florida land pebble and hard rock, and Western States hard rock also, were exported; as in former years, the greater part of the exports was Florida land pebble.

The accompanying tables show shipments of phosphate rock and "Other phosphate materials" from the United States in the years 1937 to 1940, inclusive, and in the first 9 months of 1941.

Phosphate rock [1] exported from the United States, 1937–41

Year	Long tons	Value: Total	Value: Average	Year	Long tons	Value: Total	Value: Average
1937	1,052,802	$5,818,231	$5.53	1940	751,495	$3,845,495	$5.12
1938	1,140,841	6,637,638	5.82	1941 (Jan.-Sept.)	820,396	4,600,449	5.61
1939	949,006	5,233,104	5.51				

[1] 1937–40: Excludes sintered matrix, which is included under "Other phosphate materials"; 1941: Includes sintered matrix.

Other phosphate materials [1] exported from the United States, 1937–41

Year	Long tons	Value	Year	Long tons	Value
1937	55,665	$466,850	1940	11,924	$201,047
1938	32,581	208,550	1941 (Jan.-Sept.)	1,870	94,780
1939	29,080	192,306			

[1] 1937–40: Includes bone ash, dust, and meal; animal carbon for fertilizer; basic slag, etc.; and sintered matrix. 1941: Excludes sintered matrix, which is included under "Phosphate rock."

WORLD RESERVES

The total phosphate-rock reserves of the world are now believed to exceed 26 billion tons [23]—nearly 13¾ billion tons in North America (13½ billion in the United States alone), nearly 8 billion tons in Europe (roughly 7½ billion tons in Russia), and over 3½ billion tons in Africa (by far the greater part in French North Africa). The remaining reserves, less than a billion tons, are scattered over South America Oceania, and Asia. These data are shown graphically in the following diagram (fig. 4).

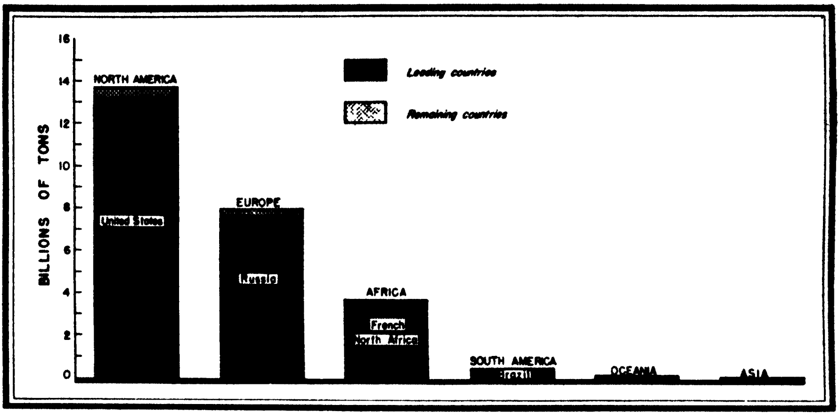

FIGURE 4.—Known phosphate-rock reserves of the world, by continents and countries, in 1942.

WORLD PRODUCTION

Few figures are available on phosphate production in foreign countries during 1941 (see following table). Presumably little change occurred in the general trends, save in the Mediterranean region and in Oceania.

In Canada, activity revived on a small scale at certain long-idle apatite mines of the Liévre River district, Quebec.[24]

TECHNOLOGIC DEVELOPMENTS

Several papers on various phases of phosphate-rock technology, in addition to those mentioned in other parts of this chapter, have appeared; they are referred to briefly here.

Easterwood [25] discusses several of the more recent developments in the phosphate industry.

Copson, Pole, and Baskervill [26] describe methods of producing metaphosphates of calcium, potassium, and sodium.

[23] Mansfield, G. R., Phosphate Deposits of the World, with Special Reference to Those of the United States: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 9–12.
Jacob, K. D., The Phosphate Rock Reserves of the United States. Commercial Fertilizer Yearbook, 1938 Issue, pp. 28–43, 55, 59.

[24] Johnson, Bertrand L. (from data received from W. B. Timm, Director, Mines and Geology Branch, Canadian Dept. of Mines and Resources), Phosphate–Canada: Bureau of Mines Mineral Trade Notes, vol. 14, No. 1, January 1942, p. 25

[25] Easterwood, H. W., Recent Developments in the Phosphate Field: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 13–19.

[26] Copson, R. L., Pole, G. R., and Baskervill, W. H., Development of Processes for Metaphosphate Productions: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 26–32.

World production of phosphate rock, 1937–41, by countries, in metric tons[1]

[Compiled by B. B. Waldbauer]

Country[1]	1937	1938	1939	1940	1941
Algeria	631,148	584,452	[2] 450,000	(3)	(3)
Angaur Island (exports)	90,652	105,578	(3)	(3)	(3)
Australia:					
New South Wales	20	244	(3)	(3)	(3)
South Australia	----------	254	(3)	(3)	(3)
Western Australia	----------	----------	----------	40	(3)
Brazil	----------	100	(3)	(3)	(3)
Canada	91	189	142	325	2,256
Chile	(3)	(3)	(3)	32,000	(3)
China[4]	8,000	8,000	8,000	(3)	(3)
Christmas Island, Straits Settlements (exports)	154,378	162,425	177,972	241,826	(3)
Egypt	517,002	458,404	547,538	183,182	(3)
Estonia	10,112	13,012	(3)	(3)	(3)
France	103,600	(3)	(3)	(3)	(3)
Germany	3,314	3,221	(3)	(3)	(3)
India, British	169	23	185	(3)	(3)
Indochina	20,252	37,341	35,694	22,266	(3)
Italy	200	----------	(3)	(3)	(3)
Japan	[2] 100,000	(3)	(3)	(3)	(3)
Madagascar	4,290	5,699	(3)	495	(3)
Makatea Island (exports)	166,726	102,941	160,680	173,177	(3)
Morocco, French (shipments)[5]	1,501,767	1,447,544	1,491,754	(3)	(3)
Nauru and Ocean Islands[6]	1,024,168	1,184,816	1,244,170	1,263,385	(3)
Netherlands Indies	26,167	33,113	18,777	34,085	(3)
Netherlands West Indies: Curaçao (exports)	101,837	99,283	(3)	6,047	(3)
New Caledonia	307	5,000	(3)	(3)	(3)
Philippine Islands	750	(3)	(3)	(3)	(3)
Rumania	950	970	(3)	(3)	(3)
Seychelles Islands (exports)	9,594	21,703	23,545	14,613	(3)
South-West Africa	----------	----------	----------	869	(3)
Spain	10,702	23,429	(3)	(3)	(3)
Sweden (apatite)	4,917	6,192	6,267	(3)	(3)
Tanganyika Territory	104	69	132	9	(3)
Tunisia	1,771,439	1,934,200	1,608,045	(3)	[2] 720,000
U. S. S. R.	[2] 900,000	(3)	(3)	(3)	(3)
United States (sold or used by producers)	4,019,686	3,799,253	3,817,368	4,066,943	4,763,559

[1] In addition to countries listed, Austria, Belgium, Poland, and Taiwan produce phosphate rock, but data of output are not available.
[2] Estimated
[3] Data not available.
[4] Estimated (Imp. Inst., London).
[5] Including exports as follows: 1937, 1,484,562 tons; 1938, 1,427,643 tons; 1939, 1,465,673 tons.
[6] Exports during fiscal year ended June 30 of year stated.

Schwartz and Munter[27] discuss in considerable detail the uses of various sodium and potassium phosphates in water softening.

Elmore, Huffman, and Wolf[28] present the results of a study of the defluorination of phosphate rock.

Larpenteur[29] discusses the application of hydroseparation and classification in the treatment of washer debris in the Florida land-pebble and Tennessee brown-rock phosphate fields.

Walthall and Striplin[30] describe the pilot-plant development of a process for manufacturing phosphoric acid by burning phosphorus in dry air and absorbing the resulting P_2O_5 vapor in concentrated aqueous solutions containing 85 percent P_2O_5.

[27] Schwartz, Charles, and Munter, C. J., Phosphates in Water Conditioning: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 32–40.
[28] Elmore, K. L., Huffman, E. O., and Wolf, W. W., Defluorinating of Phosphate Rock in the Molten State: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 40–48.
[29] Larpenteur, B. J., Particle Sizing and Hydroseparation in Phosphate Recovery: Eng. and Min. Jour., vol. 143, No. 3, March 1942, pp. 50–51.
[30] Walthall, J. H., and Striplin, M. M., Jr., Superphosphoric Acid by Absorption of Phosphorus Pentoxide Vapor: Ind. and Eng. Chem., ind. ed., vol. 33, No. 8, August 1941, pp. 995–1000.

Earhart [31] presents a study of the economic advantages and ceramic possibilities of using phosphates as opacifying agents in glazes.

Crass [32] describes the use of phosphorus in the match industry.

The use of phosphates in ceramic ware is described in a series of papers by Weyl,[33] Weyl and Kreidl,[34] and Kreidl and Weyl.[35]

Brunauer and Shultz [36] show that if phosphate rock is present when phosphorus is oxidized by steam at 1,000°–1,100° C. certain undesirable products—phosphorus tetroxide and phosphine—are eliminated.

Armstrong [37] discusses phosphate treatment as a rust preventive before painting.

The uses of various phosphates in ceramics are discussed in a recently issued Dictionary of Ceramic Materials.[38]

SUPERPHOSPHATES

The following table gives outstanding features of the superphosphate industry in the United States from 1938 to 1941.

Salient statistics of the superphosphate industry in the United States, 1938–41

	1938	1939	1940	1941
Production: [1]				
Bulk superphosphate ....short tons..	3,575,588	3,801,194	4,385,971	4,867,202
Wet base and wet mixed goods........do....	156,730	152,500	136,204	136,631
Shipments: [1]				
All superphosphate, to consumers........do....	902,490	897,749	1,048,508	1,503,373
All superphosphate, to others........do....	1,817,293	2,073,123	2,252,620	2,584,732
Base and mixed goods [2] ....do...	1,537,491	1,526,026	1,519,493	1,648,808
Stocks in manufacturers' hands, Dec. 31: [1]				
Bulk superphosphate........do....	1,361,127	1,233,297	1,285,408	1,049,268
Base and mixed goods [2] ....do....	669,503	701,649	740,914	812,973
Exports of superphosphates [3]........long tons	90,237	95,224	141,289	[4] 102,784
Imports of superphosphates [3] ....do....	18,753	17,238	10,017	[4] 6,980
Sales of phosphate rock by producers for superphosphate production........long tons.	2,074,779	2,192,779	2,564,844	2,825,456

[1] Bureau of the Census, Monthly Statistics, Superphosphate Industry, 16 percent available phosphoric acid.
[2] Includes wet and dry bases and wet and dry mixed goods.
[3] Department of Commerce.
[4] Figures cover January to September, inclusive.

Imports of superphosphates have declined in recent years; in 1940 and 1941 all came from Canada. The following table gives imports by classes and countries in 1939, 1940, and the first 9 months of 1941.

[31] Earhart, W H., Use of Phosphate Opacifying Agents in Sanitary-Ware Glazes: Bull. Am. Ceram. Soc., vol. 20, No. 9, September 1941, pp. 312–313.
[32] Crass, M. F., Jr., The Match Industry, Raw Materials Employed: Chem. Ind., vol. 48, No. 4, April 1941, pp. 424–433, No. 5, May 1941, pp. 575–579.
[33] Weyl, W. A., Phosphates in Ceramic Ware, I. In Opal Glasses: Jour. Am. Ceram. Soc., vol. 24, No. 7, July 1941, pp. 221–225. Phosphates in Ceramic Ware, II. Role of Phosphorus in Bone China: Jour. Am. Ceram. Soc., vol 24, No. 8, August 1941, pp. 245–247.
[34] Weyl, W. A., and Kreidl, N. J., Phosphates in Ceramic Ware; III. Phosphorus Compounds as Reducing and Fining Agents in Glass: Jour. Am. Ceram. Soc , vol. 24, No. 10, October 1941, pp. 337–340.
[35] Kreidl, N. J., and Weyl, W. A., Phosphates in Ceramic Ware; IV. Phosphate Glasses: Jour. Am. Ceram. Soc., vol. 24, No. 11, November 1941, pp. 372–378.
[36] Brunauer, Stephen, and Shultz, J. F., Oxidation of Phosphorus by Steam; Investigations of the Gas-Phase Oxidation in the Presence and Absence of Phosphate Rock: Ind. and Eng Chem., ind. ed., vol. 33, No. 6, June 1941, pp. 828–832.
[37] Armstrong, E., Phosphatizing Aids Rapid Finishing: Metal Treatment, vol. 6, 1940, pp. 105–110, 118.
[38] Ceramic Industry, A Complete Dictionary of Ceramic Materials: Vol. 38, No. 1, January 1942, pp. 36–116.

Superphosphates (acid phosphates) imported for consumption in the United States, 1939–41, by classes and countries

Class and country	1939		1940		1941 (Jan.–Sept.)	
	Long tons	Value	Long tons	Value	Long tons	Value
Normal (standard) (not over 25 percent P_2O_5 content):						
Belgium	450	$6,717				
Canada	9,864	145,772	7,057	$97,682	4,174	$56,187
Germany	198	2,124				
Netherlands	1,635	14,769				
	12,147	169,382	7,057	97,682	4,174	56,187
Concentrated (treble) (over 25 percent P_2O_5 content):						
Belgium	4,142	134,208				
Canada	552	23,140	2,864	39,982	2,788	69,356
Netherlands	250	7,955				
	4,944	165,303	2,864	39,982	2,788	69,356
Ammoniated:						
Belgium	27	1,585				
Canada	120	3,607	96	1,951	18	376
	147	5,192	96	1,951	18	376
	17,238	339,877	10,017	139,615	6,980	125,919

Exports of superphosphates in recent years are shown in the following table; both the total quantity and value increased yearly from 1937 to 1940, but figures for the first 9 months of 1941 appear to indicate at least temporary cessation of growth in quantity (but not value) and virtual doubling of the average value per ton.

Superphosphates exported from the United States, 1937–41

Year	Long tons	Value: Total	Value: Average	Year	Long tons	Value: Total	Value: Average
1937	78,949	$841,062	$10.65	1940	141,289	$1,655,336	$11.72
1938	90,237	945,351	10.48	1941 (Jan.–Sept.)	102,784	2,203,836	21.44
1939	95,224	1,010,336	10.61				

Supplies of phosphate rock ample for the manufacture of superphosphates needed by this country are available at the mines. However, inadequate facilities for transporting this necessary raw material to the superphosphate-producing centers, increased demands by the munitions industry for sulfuric acid—the other essential in the manufacture of superphosphates—and consequent possible shortage of supply for fertilizer manufacture, and increased demands for superphosphate affected prices, which were advanced slightly late in 1941. On February 21, 1942, a price ceiling established on superphosphate fixed the price [39] at that prevailing within 5 days before the temporary regulation was issued.

[39] Office of Price Administration, Title 32.—National Defense: Chap. 11, part 1367—Fertilizers—Temporary Maximum Price Regulation No. 1. Mixed Fertilizers, Superphosphate, and Potash.

Temporary price maximums for superphosphate, which expired April 27, 1942, were made permanent under Maximum Price Regulation 135, effective April 28, 1942, stabilizing the prices at the levels prevailing since February.

Several articles relating to the technology of the superphosphate industry appeared recently.[40]

BASIC SLAG

Basic slag is an important source of fertilizer phosphorus in many European countries, where it has become an active competitor of phosphate rock and superphosphate for that purpose in agriculture. No figures for production in Europe during 1939, 1940, or 1941 are available; data for 1935–38 are given in Minerals Yearbook, 1940, Review of 1939, p. 1319. A total of at least 4 to nearly 6 million tons is produced annually.

Little basic slag is produced in the United States—probably 25,000 to 50,000 tons a year in the Birmingham iron district of Alabama.

Only a small quantity of basic slag is imported into the United States annually. Such imports in recent years (1937–40) ranged from 405 to 714 long tons. Annual figures, 1937–41, are given in the section of this chapter on "Foreign trade."

[40] Hill, W. L., and Marshall, H. L., Composition and Properties of Superphosphates; Chemistry of Ordinary Superphosphate Manufacture: Presented at joint symposium of Division of Fertilizer Chemistry and Division of Industrial and Engineering Chemistry, American Chemical Society, Atlantic City, September 10, 1941; abs. Am. Fertilizer, vol. 95, No. 6, September 13, 1941, pp. 5–6.
Jacob, K. D., and Ross, W. H., Work cited in footnote 5.
Tremearne, T. H., and Jacob, K. D., Work cited in footnote 4.
Holmes, J. B. S., Composition of Ammoniated Superphosphate: Am. Fertilizer, vol. 95, No. 19, October 25, 1941, pp. 5–8.
Bear, F. E., Liebig and the Superphosphate Industry: Am. Fertilizer, vol 94, No. 6, March 15, 1941, pp. 10–11, 22; presented at Liebig Symposium, Am. Chem. Soc. meeting, Detroit, September 9–13, 1940.

TALC, PYROPHYLLITE, AND GROUND SOAPSTONE [1]

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

GENERAL CONDITIONS

Sales of talc, pyrophyllite, and ground soapstone in 1941 were 416,369 short tons valued at $4,701,892 (see fig. 1), or 48 percent (134,994 tons) greater in quantity and 56 percent ($1,693,572) greater in value than in 1940. Sales of crude, sawed and manufactured, and ground all increased in both quantity and value—the greatest tonnage

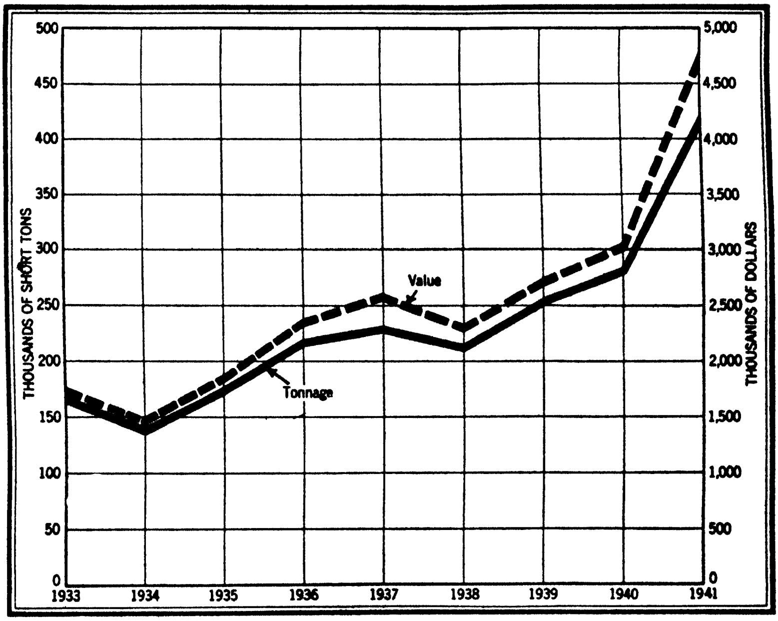

Figure 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1933–41.

increase being in the ground products. Imports of crude materials were greater in both quantity and value in the 9 months of 1941 for which figures may be published than in the entire year 1940, but imports of other classes were less in both categories. Exports (both classes) for which data are available were less in the first 9 months of 1941 than in the whole year 1940.

[1] Soapstone sold in slabs or blocks is included in the chapter on Stone.

Pyrophyllite is included with talc in this discussion because it resembles talc in certain physical properties and is interchangeable with talc in some uses, although during recent years certain specialized uses for pyrophyllite have been developed. It is a hydrous aluminum silicate, $Al_2Si_4O_{10}(OH)_2$, whereas talc is a hydrous magnesium silicate, $Mg_3Si_4O_{10}(OH)_2$. Pyrophyllite sometimes is classed as one of the kaolin minerals (see Minerals Yearbook, 1939, p. 1273).

Salient statistics of the talc, pyrophyllite, and ground soapstone industries in the United States, 1940–41

	1940		1941	
	Short tons	Value	Short tons	Value
Mined:				
Total	(1)	(1)	414,544	(1)
Used by producers	(1)	(1)	370,444	(1)
Sold by producers—				
Crude [2]	17,724	$118,424	43,823	$393,839
Sawed and manufactured	1,894	140,565	4,186	308,467
Ground	261,757	2,749,331	368,360	3,999,586
	281,375	3,008,320	416,369	4,701,892
Imports for consumption: [3]				
Crude and unground steatite and French chalk	93	1,479	[4] 223	[4] 3,249
Cut and sawed	125	20,739	[4] 71	[4] 10,611
Ground, washed, or pulverized	28,145	465,049	[4] 14,614	[4] 180,651
	28,363	487,267	[4] 14,908	[4] 194,511
Exports:				
Talc, steatite, soapstone, and pyrophyllite, crude and ground	9,402	167,992	[4] 7,777	[4] 146,674
Powder—talcum (in packages), face, and compact	(5)	945,530	(5)	[4] 865,101
		1,113,522		[4] 1,011,775

[1] Data not available.
[2] Includes pinite from Nevada.
[3] Exclusive of "manufactures, n. s. p. f., except toilet preparations," as follows: 1940, $21,568; 1941 (January–September), $9,915, quantities not available.
[4] Figures cover January to September, inclusive.
[5] Quantity not recorded.

Eleven States reported sales of talc, pyrophyllite, ground soapstone, or pinite in 1941, the same number as in 1940, but Montana replaced New Jersey as a producer. Western States increased their share of the total domestic sales from 14 to 17 percent. Eastern States furnished the remaining 83 percent in 1941—a slight decline from 1940 in relative performance.

SALES

Sales of talc, pyrophyllite, and ground soapstone by producers increased greatly in 1941 and reached an all-time record of 416,369 short tons valued at $4,701,892 (see fig. 1), an increase of 48 percent in quantity and 56 percent in value over 1940. Sales of crude, sawed and manufactured, and ground materials were all greater than in 1940. The increase in sales of crude material, however, was not as great as it appears, for this year the Bureau has attempted to record the crude sold by the primary producers.

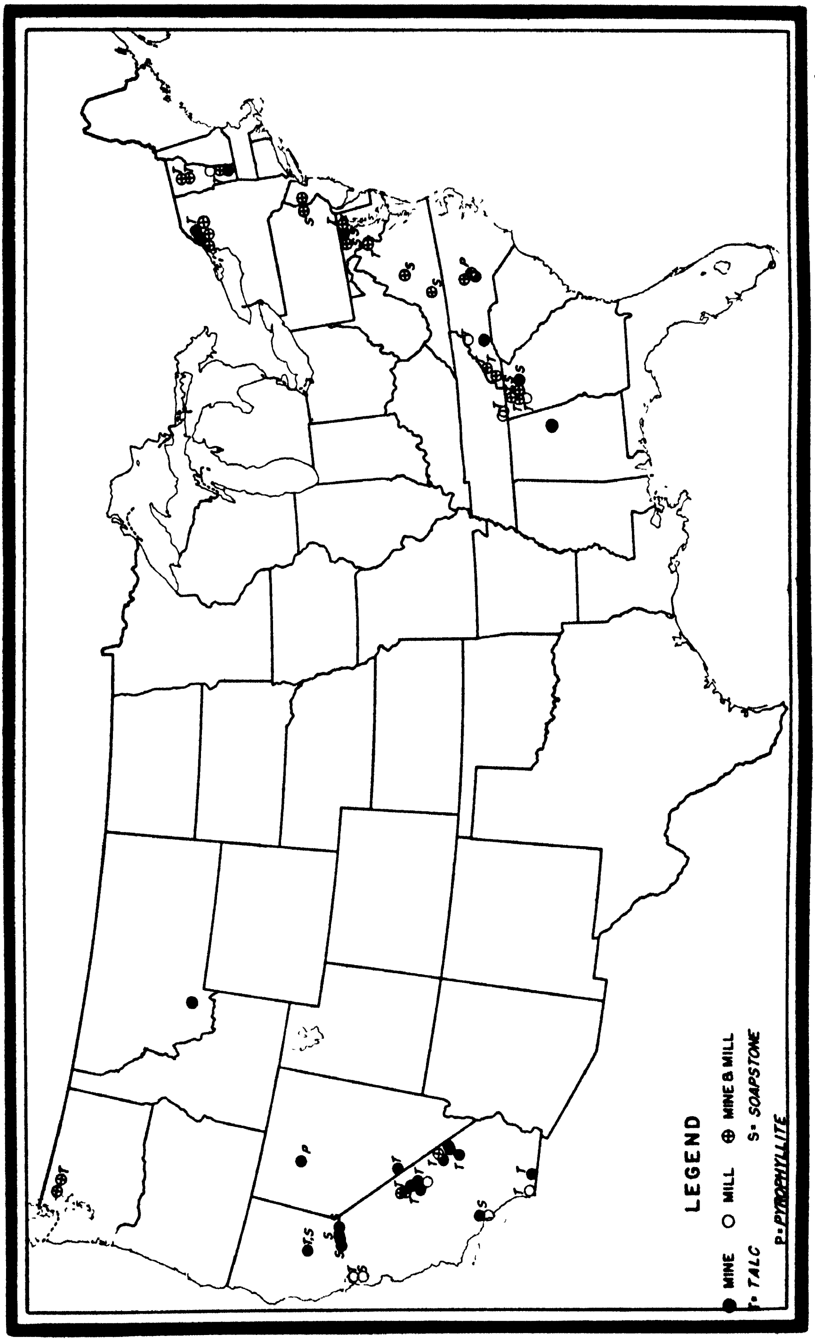

FIGURE 2.—Location of talc, pyrophyllite, and soapstone mines and mills in the United States.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1937–41, by classes

Year	Crude			Sawed and manufactured		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1937	11,087	$52,750	$4.76	1,101	$111,680	$101.44
1938	13,498	72,845	5.40	1,729	70,268	40.64
1939	15,722	82,188	5.23	1,871	77,915	41.64
1940	[1] 17,724	[1] 118,424	[1] 6.68	1,894	140,565	74.22
1941	[1] 43,823	[1] 393,839	[1] 8.99	4,186	308,467	73.69

Year	Ground			Total		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1937	217,811	$2,397,323	$11.01	229,999	$2,561,753	$11.14
1938	197,548	2,159,447	10.93	212,775	2,302,560	10.82
1939	236,383	2,540,731	10.75	253,976	2,700,834	10.63
1940	261,757	2,749,331	10.50	281,375	3,008,320	10.69
1941	368,360	3,999,586	10.86	416,369	4,701,892	11.29

[1] Includes pinite from Nevada.

Sales by States.—Markedly larger tonnages were sold or used by producers in 1941 in all States for which comparative figures can be published for 1940 and 1941, and increases ranged from 35 to 65 percent. The greatest advances in tonnage sold were in New York, North Carolina, California, and Vermont. All-time high records are known to have been established in California, Georgia, North Carolina, and New York. New York remained by far the leading producing State; its output was more than double that of any other State.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1940–41, by States

State	1940		1941	
	Short tons	Value	Short tons	Value
California	36,282	$476,926	59,203	$811,793
Georgia	20,104	219,959	28,511	364,560
Maryland	(1)	(1)	15,628	105,363
Nevada	(1)	(1)	[2] 13,178	[2] 126,433
New York	113,611	1,402,524	153,560	1,917,732
North Carolina	39,206	298,382	64,783	567,921
Vermont	38,516	423,368	57,248	663,468
Washington	4	1,394	6	2,426
Other States [3]	[2] 33,652	[2] 185,767	24,252	142,196
	281,375	3,008,320	416,369	4,701,892

[1] Included under "Other States", Bureau of Mines not at liberty to publish figures separately.
[2] Includes Nevada pinite.
[3] 1940: Maryland, Nevada, New Jersey, Pennsylvania, and Virginia; 1941. Montana, Pennsylvania, and Virginia.

MARKETS

The paint, ceramics, rubber, roofing, and paper industries consume most of the talc, pyrophyllite, and ground soapstone of domestic origin. Reports from producers to the Bureau of Mines show that these five industries took 81 percent of the total sales in 1941 compared with 75 percent in 1940. The tonnage of these commodities used by all the principal consuming industries increased sharply, an advance of over 52,000 tons being reported for the paint industry alone. The ceramic industry retained its position as the second most important market and again slightly increased its share of the total. The rubber industry more than doubled its consumption and rose to third place. Consumption in toilet preparations made a notable rise—about 140 percent—probably indicative of the replacement of foreign talcs by those of domestic origin.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1940–41, by uses

Use	1940		1941	
	Short tons	Percent of total	Short tons	Percent of total
Paint	67,875	24	120,319	29
Ceramics	48,661	18	78,990	19
Rubber	28,501	10	58,114	14
Roofing	34,347	12	40,605	10
Paper	31,657	11	37,884	9
Toilet preparations	8,818	3	21,119	5
Insecticides	(1)	(1)	10,479	2
Foundry facings	5,532	2	6,705	2
Crayons	1,829	1	3,186	1
Other uses reported [2]	29,502	10	24,280	6
Use not reported	24,653	9	14,688	3
	[3] 281,375	100	[3] 416,369	100

[1] Included under "Other uses"; figures not available.
[2] 1940 Bleaching, insecticides, plaster, refractory, textile, and other minor uses, 1941. Bleaching, insulation, lubricants, refractory, textile, and other minor uses.
[3] Includes pinite.

PRICES

The average values of sales of all grades of talc, pyrophyllite, and ground soapstone in the past 5 years, as reported to the Bureau of Mines by producers, are given in the table under Sales.

Quotations on finely ground domestic talc, per ton, f. o. b. works, carlots, on May 18, 1942, were as follows, according to the Oil, Paint and Drug Reporter:

California: $17.50 to $43.

New York: Fibrous, 325-mesh, 93 to 94 percent, $13 to $18; 99 to 99½ percent, $15.25 to $19.25; 99.95 percent, $17 to $21.

Pennsylvania: $11 to $13.50.

Vermont: $14.

Canadian talc: Carlots, delivered New York, quoted at $24 to $30 a ton.

No quotations were available on imported French and Italian talcs.

The quoted prices on pyrophyllite in the same journal were: Standard, 200-mesh, carlots, mines, $10 a ton; 325-mesh, $13; No. 3, 200-mesh, carlots, mines, $8 a ton; 325-mesh, $11. All represent

increases over quotations of a year earlier, except the last one which declined from the previously published figure of $12 a ton.

DEVELOPMENTS IN THE INDUSTRY

Talc.—Stimulated by the war need for high-frequency radio-electric insulating materials, the demand for steatite products has greatly increased. Several articles have appeared relating to the preparation and uses of such products.

Gunzenhauser[2] has presented two recent papers. The first discusses in considerable detail the use of steatitic talc and soapstone and the various methods of treating the raw materials in the preparation of the numerous types of ceramic products for insulation; the second discusses the conversion of a whitewares plant to the production of steatite.

An electric kiln developed by the Tennessee Valley Authority in the course of ceramics research at Norris, Tenn., was made available late in 1941 to the American Lava Corporation, of Chattanooga. The purpose was to avert a bottleneck in the production of steatite electric insulators for radios pending installation of increased kiln facilities at the Chattanooga plant. Since August 1940 the kiln has been operated by the Bureau of Mines under lease from the Authority, in continuation of a research program on the use of electricity in the nonmetallic mineral industries. The unfired insulators are transported from Chattanooga to Norris by truck, and finished ware is taken back. Labor for the kiln is provided by the American Lava Corporation.[3]

Thurnauer and Rodriguez[4] surveyed the literature on the crystal structure of calcined talc and steatite materials and presented the results of a study of the changes in the structure of talc and steatite bodies brought about by varying heat treatment and by the addition of different fluxes.

O'Meara,[5] of the Bureau of Mines, reported the results of a survey of domestic talcs that were obtained from various producers and from different deposits.

A new use for ground talc is in the smothering of incendiary bombs, and Canadian talc is now being shipped to Great Britain for this purpose.[6]

Davies, Pask, and Zwermann[7] presented the results of a study of talc samples. Dried and fired properties and the relation between acid solubility and physical properties were determined in four series of bodies.

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[2] Gunzenhauser, A , Steatite and Special Ceramic Materials, Their Development, Application, and Manufacture Ceram. Ind., vol 37, No 6, December 1941, pp 41–43, 46. Converting a Whitewares Plant to the Production of Steatite Ceram Ind , vol. 38, No 5, May 1942, pp. 53–54.

[3] Tennessee Valley Authority, Knoxville, Tenn., Press Release, September 17, 1941, 1 p.

[4] Thurnauer, H , and Rodriguez, A R , Notes on Constitution of Steatite Pres 44th Ann. Meeting, Am. Ceram Soc , April 19–23, 1942, abs Bull Am Ceram Soc., vol. 21, No. 4, April 15, 1942, p. 6

[5] O'Meara, R G , Beneficiation of Domestic Talcs for Production of Radio Porcelain Grades: Pres. 44th Ann. Meeting, Am. Ceram. Soc , April 19–23, 1942, abs. Bull. Am. Ceram. Soc., vol. 21, No. 4, April 15, 1942, p. 6.

[6] Bowles, Oliver, Talc, New Uses· Bureau of Mines Mineral Trade Notes, vol. 13, No. 6, December 20, 1941, p. 26.

[7] Davies, Ben, Pask, J A., and Zwermann, C H , Effect of Acid-Soluble Constituents in Talc on Physical Properties of Ceramic Bodies Pres. 44th Ann. Meeting, Am. Ceram. Soc., April 19–23, 1942; abs. Bull. Am Ceram. Soc., vol. 21, No. 4, April 15, 1942, p. 18.

Pyrophyllite.—In 1937 Greaves-Walker and associates[8] presented the results of a study of the use of pyrophyllite in refractories, which indicated that this mineral could be made into a very satisfactory fired product with properties equal or superior to those of high-heat-duty refractories. In 1941 Greaves-Walker and Amero[9] reported upon the use of pyrophyllite in unfired refractories; they concluded that a satisfactory unfired dry-pressed refractory for high heat duty may be produced, employing pyrophyllite as the major ingredient, with various specified bonding agents. The refractory would be used in operations not requiring it to come in contact with highly ferruginous or strongly basic slags.

Blume[10] describes a method of testing the fusion characteristics of nonplastic materials containing pyrophyllite, in which feldspar and flint are varied and pyrophyllite is constant.

According to Ceramic Industry,[11] pyrophyllite is used in the ceramic industry in wall-tile bodies, semivitreous dinnerware, electrical insulator bodies, and enamels. In wall-tile bodies, substitution of pyrophyllite for part or all of the flint or feldspar causes a decrease in thermal expansion, with resultant decrease in tendency of both body and glaze to fail when subjected to sudden temperature changes. Pyrophyllite in wall-tile bodies is said to increase the firing range but to decrease crazing due to thermal shock or moisture expansion, fire-cracking, and shrinkage with a resultant decrease in warpage, and to reduce wear on molds and dies.

According to the same authority, pyrophyllite is being used with talc to a limited extent in the manufacture of semivitreous dinnerware, but both minerals show a marked tendency to decrease the workability of a plastic body; for this reason, quantities sufficient to obtain the best results are not used. The total amount of pyrophyllite and talc in a dinnerware body should not exceed 20 percent; if this maximum amount is used the body should be deaired, otherwise it will work too short. When properly used, pyrophyllite will decrease the thermal and moisture expansion of semivitreous dinnerware bodies with a resulting decrease in the tendency to craze. In electrical insulation bodies very large amounts have been successfully used; it is said that bodies containing 94 to 96 percent pyrophyllite compare favorably with porcelain in mechanical and electrical characteristics and may be employed in applications not requiring high puncture values or zero porosity. They were stated to be superior to porcelain but inferior to steatite for certain high-frequency applications. Pyrophyllite is being increasingly used as a source of alumina for enamels.

Some service records of pinite, a hydrothermally altered acidic tuff suitable as a refractory lining, are summarized in a recent article.[12] This rock, composed of a mixture of sericite and pyrophyllite, is mined near Rochester, Nev. (see Minerals Yearbook, Review of 1940, p. 1291).

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[8] Greaves-Walker, A. F., Owens C. W., Hurst, T. L., and Stone, R L, The Development of Pyrophyllite Refractories and Refractory Cements North Carolina State College Eng. Exp. Sta Bull 12, 1937, 105 pp.

[9] Greaves-Walker, A F., and Amero, J. J., The Development of an Unfired Pyrophyllite Refractory: North Carolina State College Eng Exp Sta Bull 22, 1941, 108 pp

[10] Blume, A. J, Determination of Fusion Characteristics of Nonplastic Materials Bull. Am. Ceram Soc., vol. 20, No 5, May 1941, pp 153-154

[11] Ceramic Industry, A Complete Dictionary of Ceramic Materials Ceram. Ind., vol. 38, No. 1, January 1942, pp 36-116 (see p 96)

[12] Brick and Clay Record, Many American Refractory Materials can be Substituted for Foreign: Vol. 99, No. 4, October 1941, pp. 48-52.

FOREIGN TRADE [13]

Imports.—In the first 9 months of 1941, imports for consumption of "talc, steatite or soapstone, and French chalk" were 14,908 short tons valued at $194,511; figures for the entire year cannot be published.

In 1941, as in recent years, nearly all the imports consisted of materials "ground, washed, powdered, or pulverized, except toilet preparations"; only about 2 percent was of "crude and unground" and "cut and sawed" materials.

The "crude and unground" material imported during the first 9 months of 1941 totaled 223 short tons—130 tons from British India and all but 2 tons of the remainder from China and the Union of South Africa. The "cut and sawed" varieties imported in the January-September period of 1941 came entirely from Japan. Imports in the "ground, washed, powdered, or pulverized" category in the first 9 months of 1941 from both France and Italy dwindled to only a few tons each; imports from Japan proper were slightly greater in the first 9 months of 1941 than in the entire year 1940, but imports from Kwantung (Japanese-leased territory) appear separately as 3,669 tons in the first 9 months of 1941, whereas they are not itemized in the 1940 record; and imports from British India were 1,065 tons in the first 9 months of 1941, with a value of $12,705. However, declared exports of ground talc from the port of Karachi in India to the United States in the first 6 months of 1941 are said to have been valued at $76,991 compared with $25,835 in the same months of 1940.[14] Canada was the principal source of this grade of talc, and imports from that country during the first 9 months of 1941 were slightly greater than in the entire year 1940.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1937–41, by classes

Year	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures, n. s. p. f., except toilet preparations	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	324	$7,644	26,379	$423,032	72	$11,799	26,775	$442,475	102	$30,344
1938	337	5,956	21,568	351,541	129	7,866	22,034	365,363	93	25,835
1939	133	2,392	25,943	408,178	94	14,651	26,170	425,221	98	27,398
1940	93	1,479	28,145	465,049	125	20,739	28,363	487,267	(1)	21,568
1941 (Jan.-Sept.)	223	3,249	14,614	180,651	71	10,611	14,908	194,511	(1)	9,915

1 Quantity not recorded

13 Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce

14 Bureau of Foreign and Domestic Commerce, Foreign Commerce Weekly: Vol. 5, No. 7, November 15, 1941, p 37.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1940–41, by classes and by countries

Country	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures, n.s.p.f., except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1940									
Canada			4,725	$49,737			4,725	$49,737	$20
China	67	$442	3,550	34,496			3,617	34,938	20,777
Egypt			165	2,818			165	2,818	
France			5,732	94,830	10	$1,174	5,742	96,004	
Hong Kong									45
India, British			3,103	41,829			3,103	41,829	
Italy			9,456	224,007	29	6,154	9,485	230,161	
Japan	1	37	1,414	17,332	86	13,411	1,501	30,780	721
Trinidad and Tobago									5
Union of South Africa	25	1,000					25	1,000	
	93	1,479	28,145	465,049	125	20,739	28,363	487,267	21,568
1941 (Jan.–Sept.)									
Canada	2	14	4,741	49,460			4,743	49,474	
China	66	562	3,477	35,610			3,543	36,172	9,294
France			139	3,166			139	3,166	
Hong Kong									39
India, British	130	1,866	1,065	12,705			1,195	14,571	
Italy			20	519			20	519	
Japan			1,503	25,392	71	10,611	1,574	36,003	539
Kwantung			3,669	53,799			3,669	53,799	
Union of South Africa	25	807					25	807	
United Kingdom									43
	223	3,249	14,614	180,651	71	10,611	14,908	194,511	9,915

Exports.—Export figures on quantity and value of "talc, steatite, soapstone, and pyrophyllite, crude and ground," and on value of "powders—talcum (in packages), face, and compact," in 1941 are available for publication for the period January to September only and are so shown in the accompanying table.

Talcum and other powders exported from the United States, 1937–41

Year	Description	Short tons	Value	
			Total	Average
1937	Talc, steatite, and soapstone, crude and ground	8,878	$149,625	$16.85
	Powders—talcum (in packages), face, and compact	(1)	966,473	
1938	Talc, steatite, and soapstone, crude and ground	7,118	124,194	17.45
	Powders—talcum (in packages), face, and compact	(1)	978,100	
1939	Talc, steatite, and soapstone, crude and ground	9,047	162,426	17.95
	Powders—talcum (in packages), face, and compact	(1)	1,115,176	
1940	Talc, steatite, soapstone, and pyrophyllite, crude and ground	9,402	167,992	17.87
	Powders—talcum (in packages), face, and compact	(1)	945,530	
1941 [2]	Talc, steatite, soapstone, and pyrophyllite, crude and ground	7,777	146,674	18.86
	Powders—talcum (in packages), face, and compact	(1)	865,101	

[1] Quantity not recorded.
[2] January to September, inclusive.

WORLD PRODUCTION

Few production figures for talc, pyrophyllite, and soapstone by countries in 1941 are available. The only figures for the entire year 1941 are those for the United States and Uruguay. Production for the first 6 months of 1941 is given for the Union of South Africa.

Data available indicate that the United States is still by far the leading producing nation and is steadily increasing that lead.

In Scotland an impure grade of talc is being produced in Banffshire so that former imports from France and Italy can be partly replaced.[15] The talc deposits associated with the British serpentines were described in a publication issued in 1941.[16] The Indian talc deposits were described by Lees.[17] In Newfoundland some pyrophyllite is said to have been mined and shipped to England. In Canada, according to a letter in December 1941 from W. B. Timm, Director, Mines and Geology Branch, Canadian Department of Mines and Resources, to Oliver Bowles, of the Bureau of Mines, the talc industry is reported to have been extremely active throughout the year, with established producers working at capacity. As in recent years, the production came from the Madoc district, Ontario, and the Eastern Townships, Quebec. Two small new operators started work in the Madoc field in the latter part of 1941. Canadian talc is also [18] being ground for toilet preparations because Italian talc is no longer available.

World production of talc and soapstone, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Argentina	208	80	303	1,168	(2)
Australia:					
New South Wales	526	597	(2)	(2)	(2)
South Australia	991	973	1,115	1,349	(2)
Tasmania				(2)	(2)
Canada [3]	11,301	9,846	11,924	(2)	(2)
China (Manchuria) (exports)	111,140	81,215	93,772	[4] 72,495	(2)
Egypt	2,266	1,251	833	2,212	(2)
Finland	881	(2)	(2)	(2)	(2)
France	56,300	(2)	(2)	(2)	(2)
Germany:					
Austria (exports)	14,089	5,625	(2)	(2)	(2)
Bavaria	7,790	6,805	(2)	(2)	(2)
Greece	1,838	1,293	1,003	(2)	(2)
India, British	13,249	18,888	22,616	(2)	(2)
Indochina	428		400	305	(2)
Italy	45,714	53,511	(2)	(2)	(2)
Morocco, French (exports)	841	1,702	(2)	(2)	(2)
Norway	24,701	23,703	(2)	(2)	(2)
Rumania	1,976	2,256	(2)	(2)	(2)
Spain [5]	3,021	8,438	(2)	(2)	(2)
Sweden	7,937	6,797	7,195	(2)	(2)
Tanganyika Territory		38	5	6	(2)
Union of South Africa: Transvaal	376	1,554	449	1,757	[6] 883
United States [7]	208,650	193,025	230,402	255,258	377,722
Uruguay (exports)	437	952	2,460	1,699	1,862

[1] In addition to countries listed, talc or pyrophyllite is reported produced in Brazil, Bulgaria, Newfoundland, and U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Excludes soapstone, which is reported only by value and was as follows: 1937, $40,513, 1938, $35,038; 1939, $41,471. Soapstone is sold in the form of both blocks and powder.
[4] January to September, inclusive.
[5] Includes steatite, as follows—1937: 500 tons; 1938: 3,480 tons.
[6] January to June, inclusive.
[7] Talc, pyrophyllite, and ground soapstone sold by producers, includes also pinite in 1940 and 1941.

[15] Chemical and Engineering News (Am. Chem. Soc.), vol. 20, No. 7, April 10, 1942, p. 467.
[16] Wilson, G. V., and Phemister, J., Talc, Other Magnesium Minerals, and Chromite, Associated with British Serpentines: Geol. Survey of Great Britain, Dept. Sci. and Ind. Research, Wartime Pamphlet 9, 2d ed., October 1941, 27 pp.
[17] Lees, R. C., Something about Talc Compressed Air Mag., vol. 46, No. 6, June 1941, pp. 6455–6409.
[18] Industrial Minerals Journal, vol. 14, No. 3, July 1941, p. 5.

FLUORSPAR AND CRYOLITE

By H. W. DAVIS [1]

SUMMARY OUTLINE

FLUORSPAR

The domestic fluorspar industry was called upon to supply an unprecedented demand in 1941 in order to meet the requirements of steel mills and aluminum plants (both of which made new production records) and to supply the greatly accelerated needs of manufacturers of glass, enamel, and hydrofluoric acid. Producers responded by shipping 320,669 short tons of fluorspar and thus established a new record. Shipments were 37 percent greater than in 1940 and 22 percent more than the previous record (263,817 tons) made in 1918 during World War I. Shipments in 1941 were adequate not only to cover consumption, but they enabled consumers to increase inventories slightly. Moreover, there was only a small decline in stocks at mines. Shipments from Kentucky, Nevada, New Mexico, and Utah established all-time highs; the movement from Illinois (133,333 tons), although second-largest on record, was 15 percent less than the peak of 156,676 tons in 1917. Shipments by river or river-rail (74,616 tons) also made a new record. Sales of imported fluorspar, however, were 31 percent less than in 1940. On the other hand, shipments for foreign consumption, which usually are small, jumped to 12,184 tons and for the first time exceeded imports.

Sales of fluorspar to consumers in the United States totaled 316,074 short tons in 1941 (308,485 tons from domestic mines and 7,589 tons from foreign sources) compared with 236,042 tons in 1940 (225,118 tons from domestic mines and 10,924 tons from foreign sources). Total sales to the domestic steel industry increased to 220,222 tons in 1941 from 172,047 tons in 1940, sales to manufacturers of hydrofluoric acid (essential in the manufacture of artificial cryolite and aluminum fluoride—aluminum raw materials) advanced to 54,092 from 35,242 tons, and sales to makers of glass and enamel jumped to 32,051 from 20,280 tons.

[1] Figures on imports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce; those on shipments of fluorspar for foreign consumption supplied by the producers. No exports recorded by the Department of Commerce.

Despite the unprecedented demand for fluorspar in 1941, the average composite selling price ($20.98 a ton) of all grades (both domestic and foreign) delivered to consumers in the United States was only slightly more than in 1940 ($20.40). The average selling price f. o. b. Illinois-Kentucky mines of fluorspar shipped to domestic steel plants was $19.62 a short ton ($18.93 in 1940), of that shipped to manufacturers of hydrofluoric acid $26.78 ($26.10 in 1940), and of that to makers of glass and enamel $27.39 ($28.26 in 1940). The average selling price at seaboard (duty paid) of imported fluorspar shipped to steel plants was $23.58 a short ton in 1941 ($22.03 in 1940) and of that shipped to makers of hydrofluoric acid $27.33 ($27.44 in 1940).

The Office of Price Administration on January 20, 1942, requested producers not to publish or quote prices on or sell fluorspar at prices above those in effect on January 2, 1942.

Fluorspar was placed on the list requiring license for export by official order published May 13, 1941.

Salient statistics of the fluorspar industry in the United States, 1940–41

	1940		1941	
	Short tons	Value	Short tons	Value
Shipments from domestic mines—				
To consumers in United States:				
Metallurgical	170,638	$3,159,531	222,832	$4,239,436
Ceramic	20,872	554,671	32,979	847,941
Chemical	33,608	852,139	52,674	1,359,623
To consumers in foreign countries	8,482	178,467	12,184	277,782
	233,600	4,744,808	320,669	6,724,782
Stocks at mines or shipping points Dec. 31:				
Finished	43,866	(1)	31,997	(1)
Crude	30,859	(1)	40,200	(1)
	74,725	(1)	72,197	(1)
Imports for consumption—				
Containing more than 97 percent CaF_2	[2] 3,052	59,398	[3] 1,303	[3] 22,814
Containing not more than 97 percent CaF_2	8,821	83,533	[3] 6,008	[3] 50,285
	[2] 11,873	142,931	[3] 7,311	[3] 73,099
Consumption (by industries):				
Metallurgical	162,100	(1)	219,100	(1)
Ceramic	19,400	(1)	28,500	(1)
Chemical	[2] 37,000	(1)	56,000	(1)
	[2] 218,500	(1)	303,600	(1)
Stocks at consumers' plants Dec. 31:				
Metallurgical	84,500	(1)	89,900	(1)
Ceramic	4,600	(1)	7,800	(1)
Chemical	[2] 13,000	(1)	10,200	(1)
	[2] 102,100	(1)	107,900	(1)

[1] Figures not available. [2] Revised figures. [3] January to September, inclusive.

The total quantity of fluorspar shipped in and imported into the United States from about 1870 through 1941 was approximately 5,907,000 short tons, comprising about 82 percent from domestic mines and 18 percent from foreign sources.

The total shipments since commercial production was begun (around 1870) in the United States through 1941 were approximately 4,848,000 short tons, of which Illinois and Kentucky contributed 56 and 36 percent, respectively. Imports of fluorspar into the United

States from 1910 through 1941 were about 902,000 short tons, and imports before 1910 are estimated at 157,000 tons—a total of about 1,059,000 tons, of which the United Kingdom and Germany contributed 50 and 20 percent, respectively.

Fluorspar shipped[1] from mines in the United States, 1880–1941, by States, in short tons[2]

Year	Arizona	Colorado	Illinois	Kentucky	Nevada	New Mexico	Other States[3]	Total
1880–1909[4]	718	5,807	330,120	203,929	----------	710	1,020	542,304
1910–19[4]	843	83,220	1,004,633	281,124	400	20,997	6,110	1,397,327
1920–29[4]	181	71,920	630,804	512,518	2,344	31,216	2,319	1,251,302
1930	----------	9,248	44,134	39,181	974	2,312	----------	95,849
1931	----------	529	28,072	23,462	395	1,026	----------	53,484
1932	----------	333	9,615	14,725	49	529	----------	25,251
1933	----------	742	36,075	34,614	505	994	----------	72,930
1934	----------	6,537	33,234	43,163	631	2,040	181	85,786
1935	----------	6,978	44,120	68,679	1,040	2,726	198	123,741
1936	40	9,412	82,056	80,241	2,126	2,045	957	176,877
1937	610	7,883	78,664	87,296	2,544	3,324	909	181,230
1938	1,093	1,704	35,368	34,803	2,909	4,066	460	80,403
1939	(5)	7,569	75,257	89,563	3,520	(5)	385	182,771
1940	(5)	11,032	104,698	103,939	5,803	(5)	142	233,600
1941	(5)	15,566	133,333	142,862	8,967	(5)	922	320,669
	(5)	238,480	2,670,183	1,760,099	32,207	(5)	13,603	4,823,524

[1] Figures for 1880–1905 represent production.
[2] Figures on production not recorded for Colorado before 1905, for Illinois before 1880, and for Kentucky before 1886 and for 1888–95; total unrecorded production, chiefly from Illinois, estimated at 25,000 tons.
[3] California, New Hampshire, Tennessee, Texas, Utah, and Washington.
[4] Figures by years for 1880–1909 are given in Mineral Resources of the United States, 1925, pt. 2, p. 13; for 1910–29 in Minerals Yearbook, Review of 1940, p. 1297.
[5] Bureau of Mines not at liberty to publish figures.

Fluorspar imported into the United States, 1910–41, by countries, in short tons[1]

Year	Africa	Canada	France	Germany	Newfoundland	Spain	United Kingdom	Other countries[2]	Total
1910–19[3]	----------	2,433	----------	1,227	----------	----------	183,265	11	186,936
1920–29[3]	54,550	16,197	57,565	119,903	----------	11,774	178,482	16,161	454,632
1930	2,712	----------	23,313	23,797	----------	6,784	5,756	2,541	64,903
1931	3,672	280	4,462	6,491	----------	4,068	----------	1,736	20,709
1932	1,587	----------	1,578	5,842	----------	2,659	1	1,569	13,236
1933	712	----------	204	4,333	320	4,262	17	560	10,408
1934	1,997	187	----------	8,224	745	4,914	466	172	16,705
1935	1,347	1	----------	9,843	----------	5,094	----------	55	16,340
1936	947	----------	1,595	12,944	4,317	5,701	----------	----------	25,504
1937	1,194	----------	14,158	14,501	5,520	566	----------	1,124	37,063
1938	3,359	----------	7,411	3,062	4,752	309	644	85	19,622
1939	----------	----------	13,094	19	2,268	168	56	697	16,302
1940	----------	----------	5,735	----------	3,640	112	----------	2,384	11,871
1941[4]	----------	----------	----------	----------	----------	3,070	2	4,239	7,311
	72,077	19,038	129,115	210,186	21,562	49,481	368,689	31,334	901,542

[1] Imports Aug. 1 to Dec. 31, 1909, totaled 6,971 tons. Earlier imports not separately recorded but estimated at 150,000 tons and virtually all from United Kingdom.
[2] Argentina, Australia, Austria-Hungary, Belgium, China, Czechoslovakia, Italy, Mexico, Netherlands, Norway, Tunisia, and Soviet Russia in Asia.
[3] Figures by years for 1910–29 are given in Minerals Yearbook, Review of 1940, p. 1298.
[4] January to September, inclusive.

PRODUCTION AND SHIPMENTS

Production of fluorspar (expressed in terms of finished product) totaled 313,000 short tons in 1941 compared with 244,000 tons in 1940. Of the output in 1941, 7 mines producing over 10,000 tons each supplied 106,000 tons or 34 percent, 14 mines producing 5,000 to 10,000 tons each supplied 102,000 tons or 33 percent, 26 mines producing 1,000 to 5,000 tons each supplied 63,000 tons or 20 percent,

and 12 mines producing 500 to 1,000 tons each supplied 8,000 tons or 2 percent. Thus, 59 mines produced 279,000 tons or 89 percent of the total. The remainder (34,000 tons or 11 percent) was produced in quantities ranging from a few tons to 500 tons from an undetermined number of small mines and prospects and reclaimed from mill ponds, waste dumps, and old workings of abandoned mines.

Fluorspar shipments from domestic mines in 1941 were the largest on record; they aggregated 320,669 short tons valued at $6,724,782, increases of 37 percent in quantity and 42 percent in total value over 1940, and were equivalent to 257 percent of the average annual tonnage shipped in the 5-year period 1926–30. Of the 1941 total, 74,616 tons (an all-time high) was shipped by river or river-rail for delivery to consumers in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia.

In 1941, mines operated by or for consumers shipped 59,644 short tons of fluorspar for use in their own plants compared with 53,162 tons in 1940.

The average value of all grades of domestic fluorspar shipped in 1941 was $20.97 a short ton ($0.66 more than the 1940 average).

The following table shows shipments of fluorspar, by States, during 1940 and 1941.

Fluorspar shipped from mines in the United States, 1940–41, by States

State	1940			1941		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Colorado	11,032	$163,285	$14.80	15,566	$225,069	$14.46
Illinois	104,698	2,313,747	22 10	133,333	3,047,247	22.85
Kentucky	103,939	2,043,866	19.66	142,862	2,957,982	20.71
Arizona, New Mexico, Texas	7,986	139,675	17.49	19,089	355,951	18.65
Nevada	5,803	84,235	14.17	8,967	138,533	14.11
Utah	142			748		
Washington				104		
	233,600	4,744,808	20 31	320,669	6,724,782	20.97

SHIPMENTS, BY USES

The steel industry is the predominant purchaser of fluorspar, as is evident from the following table; it also consumes considerable hydrofluoric acid and sodium fluoride, in which fluorspar is the basic material.

Fluorspar shipped from mines in the United States, 1940–41, by uses

Use	1940				1941			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	69 68	162,772	$2,998,054	$18.42	66.77	214,120	$4,048,454	$18.91
Foundry	1 21	2,829	50,758	17.94	.85	2,724	53,044	19.47
Glass and enamel	8.68	20,269	548,069	27.04	9.99	32,051	839,547	26.19
Hydrofluoric acid	14.39	33,608	852,139	25.36	16.43	52,674	1,359,623	25.81
Miscellaneous	2.41	5,640	117,321	20.80	2.16	6,916	146,332	21.16
	96.37	225,118	4,566,341	20.28	96.20	308,485	6,447,000	20.90
Foreign consumption	3.63	8,482	178,467	21.04	3.80	12,184	277,782	22.80
	100.00	233,600	4,744,808	20.31	.100.00	320,669	6,724,782	20.97

USES

As figure 1 shows graphically, the steel industry is the chief consumer of fluorspar in the United States. The second-largest use is in the manufacture of hydrofluoric acid, which is employed to make artificial cryolite and aluminum fluoride (aluminum raw materials) and refrigerating mediums; hydrofluoric acid is also used in the electrolytic refining of metals, the pickling of metals, chromium plating, and the etching of glassware, as well as for other purposes. The glass and enamel industries rank third and fourth, respectively, in importance. Comparatively small quantities of fluorspar are used in a number of miscellaneous operations, such as production of the finer grades of iron castings, chilled-iron rolls, brass and bronze ingots, nickel and Monel metal, magnesium, cement, ferro-alloys, carbon electrodes, and calcium carbide and cyanamid; in refining lead and silver; in extracting various rare metals from their ores; in smelting refractory ores of gold,

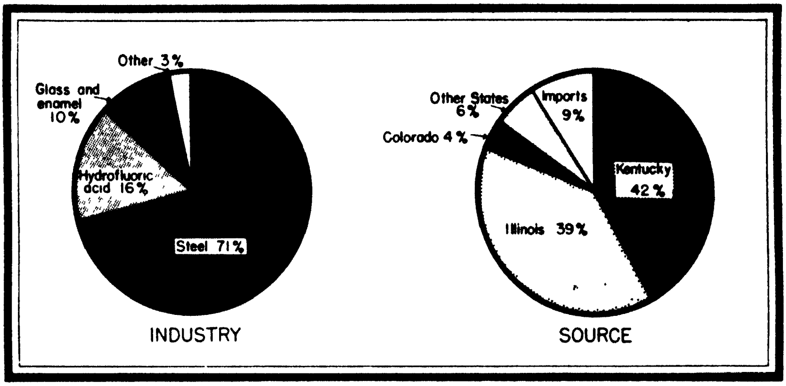

FIGURE 1.—Average annual fluorspar sales (domestic and foreign) to consumers in the United States, 1937–41, by consuming industries and by sources.

silver, and copper; as a paint pigment; as a binder for abrasives; and in a formula for coating welding rods.

Consumption of fluorspar in the manufacture of bessemer steel was reported to the Bureau of Mines for the first time in 1941. According to The Foundry: [2]

> While it is well-known that the basic bessemer process reduces the phosphorus content of steel, it is only recently that dephosphorization has been applied to the acid bessemer process using cold fluxes. Flux employed is composed of 50 percent impure lime, 30 percent dry roll scale, and 20 percent fluorspar. In use the regular slag formed after blowing the heat is removed by holding it back with a wooden block as the molten steel is poured into the ladle. The cold flux is added to the stream flowing into the ladle at a rate to insure a good boiling action. Reaction is said to be complete in about 30 seconds, and the phosphorus reduced from 0.095 to 0.100 percent to 0.020 to 0.040 percent in that time.

A comparatively small quantity of sodium fluoride—a derivative of hydrofluoric acid—is used in the steel industry. According to Metals and Alloys: [3]

> Rimming steels generally contain 0.12 percent C maximum and 0.5 percent Mn maximum. Solidification is decidedly affected by the evolution of gas, mainly carbon monoxide, resulting either from reaction or reduced solubility. The

[2] The Foundry, May 1941, vol. 69, No. 5, p. 146.
[3] Metals and Alloys, April 1941, vol. 13, No. 4, p. 472.

principal recent innovations in manufacture are (1) special molds (their use is widespread in America) and (2) use of sodium fluoride. Sodium fluoride additions have an effect opposite to that of aluminum, namely, they speed up the effervescence of the ingot. The standard procedure is to add 2 ounces per ton during teeming. The effect is most marked in small ingots in which the height to cross-section ratio is over 4 : 1. Sodium fluoride addition at the start of pouring increases the rimming action in the lower half of the ingot, thereby giving an ingot with more uniform skin thickness and surface quality. Sodium fluoride is especially useful for heats that are somewhat sluggish in rimming and that might give second-grade ingots.

Chief commercial grades of fluorspar

Name	Chief use	Form	Specifications, in percent		
			CaF_2 (minimum)	SiO_2 (maximum)	Fe_2O_3 (maximum)
Metallurgical	Basic open-hearth steel.	Washed gravel, less than 1 inch and not more than 15 percent of fines.	85	5	
Ceramic	Glass and enamel	Ground: Coarse, fine, and extra fine.	95	3	0.12
Acid	Hydrofluoric acid	Lump, gravel, and ground	98	1	

CONSUMPTION AND CONSUMERS' STOCKS

The following tables give data on consumption and consumers' stocks of fluorspar.

Fluorspar (domestic and foreign) consumed and in stock in the United States, 1940–41, by industries, in short tons

Industry	1940		1941	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	143,800	79,800	191,300	84,200
Electric-furnace steel	11,700	1,700	18,300	2,500
Foundry	2,700	900	2,600	1,000
Ferro-alloys	1,900	900	2,500	1,000
Hydrofluoric acid	[1] 37,000	[1] 13,000	56,000	10,200
Glass and enamel	18,900	4,400	27,600	7,500
Miscellanecus	2,500	1,400	5,300	1,500
	[1] 218,500	[1] 102,100	303,600	107,900

[1] Revised figures.

Consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1937–41

	1937	1938	1939	1940	1941
Production of basic open-hearth steel ingots and castings ... long tons	46,361,000	25,868,000	43,368,000	55,038,000	65,993,000
Consumption of fluorspar in basic open-hearth steel production ... short tons	138,900	73,600	116,200	143,800	191,300
Consumption of fluorspar per ton of steel made ... pounds	6.0	5.7	5.4	5.2	5.8
Stocks of fluorspar on hand at steel plants at end of year ... short tons	71,400	55,000	69,900	79,800	84,200

The quantity of fluorspar used by individual plants per long ton of basic open-hearth steel produced ranges from 1 to 50 pounds—a relatively small proportion of the furnace charge. The average is generally 5 to 8 pounds. It is noteworthy that from 1921 (the first year for which these data were collected) to 1940 the average consumption of fluorspar per ton of steel made declined almost steadily from 8.2 to 5.2 pounds. However, it increased to 5.8 pounds in 1941. The gain in 1941 was due partly to the manufacture of proportionately more armor steel, a poorer quality of scrap, higher charges of lime, and rushing of heats. Although electric-furnace steel plants are small users of fluorspar as compared with basic open-hearth steel plants, the average consumption of fluorspar (14 pounds) per long ton of electric steel made is substantially greater. The following table shows the variation in average consumption of fluorspar per ton of basic open-hearth steel over a 5-year period in certain plants that make about 88 percent of the total.

Average consumption of fluorspar (domestic and foreign) per long ton of steel, 1937–41, in pounds

1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
13.867	12.548	14.079	15.973	18.231	7.360	8 420	6 337	5.972	6.516
5.623	4.457	3 623	3.4[illegible]3	3 716	6.623	11.984	8.506	8.369	9.910
4.376	3 845	3 793	3.929	4.268	4 358	3 831	3 171	.807	1.977
8.795	8.297	8.095	5.566	5.230	6.619	6.448	6.551	7.447	7.436
3.550	6.843	6.814	6.137	6.368	8.895	8.340	9 370	8.692	7.940
5.275	3.694	3 709	4.183	4 932	5 236	6.195	4 578	5 043	5.924
6.404	6.806	4.958	4.599	5.874	6.816	6.097	6.896	7.356	8.263

QUOTED PRICES

According to Iron Age, in 1941 the quoted price f. o. b. Illinois-Kentucky mines for fluxing gravel and No. 2 lump fluorspar increased from \$20 a short ton on January 1 to \$25 by December 31. Smaller increases were made in the quoted prices of No. 1 ground and acid-grade fluorspar. Imported fluxing-gravel fluorspar (at seaboard, duty paid) was quoted nominally at \$25.50 a short ton throughout the year.

As a consequence of the price rise in fluorspar, the Office of Price Administration on January 20, 1942, notified producers of fluorspar that it regarded any further increase in prices as inimical to the national welfare and requested producers "not to publish or quote prices on, nor sell your fluorspar at prices above your prices in effect on January 2, 1942." If any fluorspar producer considers it necessary to increase prices above the January 2 level, the Administrator requested him to notify the Office of Price Administration 1 month in advance of the date upon which the intended increase would take effect and to submit a detailed factual statement of reasons that the producer believed would justify the proposed increase, including financial data.

STOCKS AT MINES OR SHIPPING POINTS

According to reports of producers, the quantity of fluorspar in stock at mines or shipping points at the close of 1941 totaled 72,197 tons, or 3 percent less than in 1940. These stocks comprised about 40,000

tons of crude fluorspar (calculated to be equivalent to 25,000 tons of finished fluorspar) and 31,997 tons of finished fluorspar.

Stocks of fluorspar at mines or shipping points in the United States, December 31, 1940 and 1941, by States, in short tons

State	1940			1941		
	Crude [1]	Finished	Total	Crude [1]	Finished	Total
Arizona				30		30
California	150		150	150		150
Colorado	205	364	569	666	434	1,100
Illinois	23,934	18,269	42,203	23,711	19,966	43,677
Kentucky	3,906	22,707	26,613	12,579	10,981	23,560
New Mexico	2,604	2,483	5,087	2,539	425	2,964
Texas		43	43		43	43
Utah	60		60	525	110	635
Washington					38	38
	30,859	43,866	74,725	40,200	31,997	72,197

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed

TECHNOLOGIC DEVELOPMENTS

The capacity of flotation plants in the United States was increased substantially in 1941 by additions to or improvements in present mills; new plants are now under construction. At the plant of the Rosiclare Lead & Fluorspar Mining Co., more flotation cells were added, the ball mill was enlarged, and other improvements were made. The Mahoning Mining Co. and Aluminum Ore Co. expanded and improved their flotation mills during 1941. The Colorado Fluorspar Corporation made improvements in its mill at Salida, Colo.; P. L. Grattan is rebuilding his flotation plant at Deming, N. Mex.; and J. Irving Crowell, Jr., installed flotation cells in his mill near Beatty, Nev. The General Chemical Co., which operates a flotation plant at Deming, N. Mex., is constructing a flotation plant near Jamestown, Colo., to treat ore from its mines in Boulder County. The Fluorspar Processing Co. is installing a combination flotation-concentrating mill near Salida, Colo. Output of flotation concentrates was 64,627 short tons in 1941 compared with 41,467 tons in 1940.

A Bendelari jig, the first to be used in the Illinois-Kentucky district, was installed in the mill of the Fluorspar Products Corporation near Rosiclare, Ill. This type of jig is also used by Navajo Fluorspar Mines in its mill near Grants, N. Mex.

Air tables, an innovation in milling fluorspar, were included in the equipment installed in the mill of the Big Creek Fluorspar Co. near Rosiclare, Ill.

A method of concentrating fluorspar ores is covered by United States Patent 2,263,552 granted to C. O. Anderson and others, assignors to Mahoning Mining Co. A principal object of the invention is to provide a method for flotation concentration of fluorspar from ores high in calcite, by means of which acid-grade fluorspar can be produced commercially without desliming treatment before flotation of the ore. A further object of the invention is to provide a method of this character that will avoid loss of material ore values through removal of the fines or slimes preparatory to flotation. Another object is to provide a method of flotation concentration of fluorspar

from ores high in calcite, in which the "middlings" can recirculate in the flow sheet without material objectionable effects.

FLUORSPAR INDUSTRY IN 1941, BY STATES

Arizona.—Production in Arizona came from mines and prospects in Greenlee and Pima Counties, and most of it was shipped to the flotation plants at Deming and Lordsburg, N. Mex. The flotation concentrates recovered from the fluorspar, instead of the run-of-mine material, have been credited to Arizona in the statistics. The flotation plant of the Southwestern Mineral Co. at Fox, Ariz., stopped milling fluorspar on April 1, 1940, and the mill was used to beneficiate complex ores from New Mexico. The fluorspar milled at the Fox plant in 1941 came from the Great Eagle and Mohawk mines in New Mexico. Plans for resuming production of fluorspar at the Fox plant in 1942 are under consideration. Bert L. Forbis and N. A. Gonzales shipped fluorspar to steel plants and iron foundries from the Polly Ann mine in Greenlee County and the Fluxore claims in Pima County, respectively.

California.—Some Nevada fluorspar was ground at the plant of the Industrial Minerals & Chemical Co. at West Berkeley and shipped to the ceramic trade during 1941. The ground fluorspar has been credited to Nevada in the statistics.

Colorado.—Shipments of fluorspar from Colorado mines totaled 15,566 short tons in 1941 compared with 11,032 tons in 1940 and have been exceeded only in 1917 and 1918. Most of the 1941 shipments went to steel plants, but some went to iron foundries and to ferro-alloy, cement, glass, and enamel plants. Production in 1941 came from Boulder, Chaffee, Custer, Jackson, and Mineral Counties, but mines in Chaffee and Mineral Counties supplied 96 percent of the State total.

After considerable experimental work and a small production of fluxing-gravel fluorspar, Harry M. Williamson reports that his mill in Boulder County has been remodeled to produce acid-grade fluorspar and that the shaft at his Emmett mine was sunk about 175 feet during 1941. The General Chemical Co., which acquired the Chancellor, Yellow Girl, and Burlington mines in Boulder County in 1940, is rehabilitating these mines and building a flotation plant, which is expected to begin production in May 1942. The American Fluorspar Corporation did considerable development work at its mines in Chaffee County, and a flotation mill to be operated by the Fluorspar Processing Co. is being built on its property. The Colorado Fluorspar Corporation at Salida, in addition to a large increase in production of fluxing gravel and foundry lump fluorspar in 1941, shipped about 900 tons of flotation concentrate to the glass and enamel trades. The Western Feldspar Milling Co. shipped 731 tons of ground fluorspar to the glass trade in 1941. The Western Fluorspar Corporation in late 1941 leased the property of the Colorado Fluorspar Corporation (not affiliated with the Colorado Fluorspar Corporation, Salida) near Northgate, Jackson County; it has been rehabilitating the mine and remodeling and enlarging the mill, which is hoped to be in production in July 1942. Three 5-cell Harz jigs are being built, trommel screens are being replaced by vibrating screens, and Diesel power is being substituted for steam.

Illinois.—Approximately 248,000 short tons of fluorspar-bearing material, equivalent to 135,000 tons of finished fluorspar, were mined in 1941 compared with about 213,000 tons, equivalent to 111,000 tons of finished fluorspar, in 1940. Of the finished fluorspar produced in 1941, it is estimated that 71,000 tons were from mines where the fluorspar occurs in veins, chiefly fault fissures, and 64,000 tons from mines where the fluorspar occurs in flat-lying tabular masses, locally called blanket formations. Of the fluorspar produced in Illinois in 1941, about 97 percent came from Hardin County and 3 percent from Pope County.

Fluorspar-bearing material milled in Illinois in 1941 totaled 248,000 tons, from which about 135,000 tons of finished fluorspar were recovered—a ratio of 1.84:1. Considerable fluorspar of Kentucky origin is milled in Illinois, but the finished fluorspar so recovered, as well as that shipped, is credited to Kentucky in the statistics.

Shipments from Illinois totaled 133,333 tons in 1941 compared with 104,698 tons in 1940; 39,918 tons were shipped by river or river-rail to consumers in 1941 compared with 36,756 tons in 1940. Shipments from Illinois were larger in 1941 than in any year except 1917, when they totaled 156,676 tons.

The Argo, Blue Diggings, Cave in Rock, Crystal, Daisy, W. L. Davis, Deardorff, Hamp, Hillside, Humm, Lead Hill, Midway-Air Shaft, North Boundary, Rosiclare, Stewart, and Victory mines supplied about 85 percent of the total finished fluorspar produced in Hardin County in 1941; the remainder of the county production came from many mines and prospects, including the Big Creek, Boundary Shaft, Cooper, Diamond, Dimick, DuBois, Eureka No. 4 and No. 5, Indiana, Kamm, Pell, Preen, Sheldon, Spar Mountain, Twitchell, and Wall.

The Fluorspar Products Corporation operated the Lead Hill, Stewart, and Twitchell mines and also milled purchased ore from various properties. Shipments were 114 percent greater than in 1940. A 5-cell Bendelari jig was added to the mill, and a change from steam to electricity is reported to have effected much smoother operation.

The Aluminum Ore Co. produced 27 percent more fluorspar at its flotation plant in 1941 than in 1940; the plant was closed from January 11 to 23, 1941, and during November 1940 because of a strike at its East St. Louis plant, where artificial cryolite and aluminum fluoride are made from fluorspar. The capacity of the flotation plant was enlarged substantially in 1941, and another substantial expansion, which will be completed about July 1, 1942, is now in progress. Additional drying and grinding facilities are also being installed to handle the increased output. Drifting and raising at the Argo mine extended levels down to 700 feet; minor developments were carried out at the Blue Diggings mine; and a vertical shaft to a depth of 300 feet was completed at the Hamp mine.

At the Crystal mine of the Crystal Fluorspar Co. additions were made to the mill between January 1 and March 21 (there was no production during this interval); consequently, output during 1941 was 10 percent less than in 1940. Prospecting and development work included 13,695 feet of churn drilling.

Output of gravel fluorspar and flotation concentrates by Hillside Fluor Spar Mines was 36 and 353 percent, respectively, greater than in 1940. The mill feed came chiefly from the Hillside mine at Rosi-

clare, Ill., Keystone and Ada Florence mines near Marion, Ky., and tailings from previous milling operations.

The Rosiclare Lead & Fluorspar Mining Co. operated the Boundary Shaft, Daisy, Eureka No. 4 and No. 5, Midway-Air Shaft, North Boundary, and Rosiclare mines in 1941; production was at about the same rate as in 1940. Output at its flotation plant, however, was about five times that in 1940. The flotation plant has been described by Edwards.[4] The Rosiclare mine, which had been flooded since January 1924, resumed production in 1941; it has now been cleaned out to the 700-foot level, where development work will soon be initiated. Unwatering the Rosiclare mine has been described by Cronk [5] and the mine pumping plant and new power plant by Edwards.[6] The company did considerable development work to determine the extension of the Argo fault on its property; a 1,000-foot crosscut has been driven from the 600-foot level of the Daisy mine west to intersect the Argo fault.

The Victory mine of the Victory Fluorspar Mining Co. produced 187 percent more fluorspar than in 1940.

The Cave-in-Rock Spar Co. operated its No. 1 and No. 2 mills on ore from its own mines, as well as on purchased ore; production of finished fluorspar was substantially greater than in 1940. No. 1 mill was leased to and operated by the Continental Fluorspar Co. for a 4-month period and milled purchased ore. The company did some developing at the Pell and Teems properties and made improvements in both mills.

The flotation mill of the Mahoning Mining Co. operated at capacity in 1941, and production of fluorspar concentrates was 50 percent greater than in 1940. The mill feed comprised ore from the W. L. Davis and Deardorff mines and a small quantity of purchased ore. Of the fluorspar shipped in 1941, 86 percent was acid-grade and 14 percent pelletized gravel; 25 percent of the acid-grade was shipped for foreign consumption The flotation plant has been described by Trauffer.[7]

Ralph E. Jones and J. R. Ginn completed small mills near Rosiclare and Elizabethtown, respectively, in 1941. The Big Creek Fluorspar Co. also completed a mill near Rosiclare in 1941; equipment includes air tables, an innovation in fluorspar milling.

The Atlas Fluorspar Co. operated its jig mill on purchased ore and did some custom milling. The mill was run during the latter part of 1941 by the Crown Fluorspar Co., which also milled purchased ore and reported exploration and development work at properties it has under lease.

Production at the Humm mine, operated by C. C. Mackey, was about the same as in 1940. Beecher Williams reported sinking a 160-foot shaft on the Humm property in 1941.

The Douglas, Lost 40, and Roberts mines were the chief producers of fluorspar in Pope County during 1941. Knight, Knight & Clark operated its mill on ore from the Douglas mine. Production at the Lost 40 mine was sold to local mills for milling. The Kentucky

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[4] Edwards, J. H., Use of Flotation Increases in Illinois Fluorspar Field: Eng. and Min. Jour., October 1941, vol. 142, No. 10, pp. 47–48.

[5] Cronk, A. H., Unwatering the Rosiclare Mine: Min. Cong. Jour., July 1941, vol. 27, No. 7, pp. 10–13.

[6] Edwards, J. H., Mine Pumping Plant Electrified at Rosiclare Fluorspar Property: Eng. and Min. Jour., June 1941, vol. 142, No. 6, pp. 39–41; New Power Plant for Rosiclare Fluorspar Operations: Eng. and Min. Jour., July 1941, vol. 142, No. 7, pp 49–50.

[7] Trauffer, W. E., Fluorspar Separated by Flotation at New Plant in Illinois-Kentucky Field: Pit and Quarry, May 1941, vol. 33, pp. 39–42.

Fluor Spar Co. acquired the Knight mine on June 28 and renamed it the Roberts mine. It was equipped and brought into production the latter part of 1941.

Kentucky.—Production of fluorspar (expressed in terms of finished product) in Kentucky was about 136,000 short tons in 1941 compared with 107,000 tons in 1940. Shipments, which exceeded the previous all-time record of 1940 by 37 percent, were 142,862 tons compared with 103,939 tons in 1940; of the 1941 total, 34,698 tons were shipped by rail or river-rail to consumers compared with 29,672 tons in 1940.

Production in Caldwell County, totaling about 8,000 tons, came chiefly from the H. & W., Hollowell & Hobby, Marble, McNeely, and Tyrie mines. A large increase in production was reported at the Hollowell & Hobby mine, which was acquired by the New York & Kentucky Mining Co. in 1940.

The Marble mine was leased on June 19 by the Marble Mining Co., which also leased the Crook mill at Crider. A 96-foot shaft was sunk at the mine; and the mill, which had been idle for many years, was rehabilitated.

Production at the McNeely mine, operated by J. D. Summers & Co., was discontinued in May, owing to exhaustion of known ore bodies.

Production in Crittenden County, totaling 105,000 short tons, came chiefly from the Ada Florence, Bachelor, Davenport, Gillis, Keystone, Pigmy, Summers, Tabb, and Watson (Eagle) mines, which contributed 85 percent of the county total. Most of the remainder came from many smaller mines (including the Beard, Blue, Brown, Dyke, Haffaw, Mary Belle, Memphis, Pogue, Susie Beeler, and Watkins) and from numerous prospects; some was reclaimed from mill ponds, waste dumps, and old workings of abandoned mines.

The Beard, Brown, Cross, Haffaw, Mary Belle, Memphis, and Susie Beeler mines of the Aluminum Ore Co. were operated by lessees at a greatly reduced rate during 1941. The surface plants at these mines, as well as those at other mines of the company in Kentucky, have been removed, and its mill at Marion has discontinued operation. The mill site will be used for the accumulation of fluorspar purchased from local contractors. The company operates mines and a flotation mill near Rosiclare, Ill., where operations will proceed at a greatly increased rate.

The Watson mine of the Eagle Fluor Spar Co. was operated on a two-shift basis, and the output of finished fluorspar was 13 percent larger than in 1940.

R. J. Forester's mill handled ore from his Summers mine and some purchased ore, recovering 37 percent more finished fluorspar than in 1940.

The Tabb mines and mill of the United States Coal & Coke Co. produced 19 percent more finished fluorspar than in 1940; shipments, however, were 4 percent less. In addition to the production from the Tabb mines, a contractor made a small output on the company property. Some purchased ore was also treated in the company mill.

The Kentucky Fluor Spar Co., which operates a mill a short distance south of Marion, did the largest volume of business in its history; sales were 35 percent greater than in 1940. In 1941 the com-

pany operated the C. R. Babb and Ellis mines in Livingston County, Ky., and the Roberts mine in Pope County, Ill.; about half the company supply came from these mines. The remainder was purchased chiefly from the Blue, Dyke, Hollowell & Hobby, McNeely, Nancy Hanks, and Watkins mines in Kentucky and the Humm and Kamm mines in Illinois.

The Ada Florence and Keystone mines of Hillside Fluor Spar Mines were operated at a substantially increased rate in 1941. Although the fluorspar from these mines is finished at the company mill at Rosiclare, Ill., production and shipments are credited to Kentucky in the statistics.

A newly discovered ore body of considerable length and depth was developed at the Pigmy mine of the Pigmy Corporation in 1941. Production was about double that in 1940.

Exploration by crosscut at the 130- and 260-foot levels of the Davenport mine, both in the vicinity of the main shaft, disclosed at least two hitherto unknown ore bodies east of those already worked; they promise considerable tonnage. Production was about the same as during 1940.

The Pogue mine was leased in July 1941 by the Marble Mining Co., which cleaned out an old filled-in abandoned shaft and retimbered it to the 175-foot level. Washing equipment was installed at the mine. A small tonnage of fluxing-gravel fluorspar was produced in 1941. During October the company also leased the Sullinger mine and installed washing equipment.

In 1941 the Delhi Fluorspar Corporation did considerable development work at its Bachelor mine and installed a new double log washer and bath house. Production was about double that in 1940.

The capacity of the mill of the Howard Easley Corporation was enlarged to handle one-third more tonnage. This corporation does not operate any mines but does milling upon a custom basis for others. It also purchases fluorspar from many mines and prospects, milling some of this before shipment.

In Livingston County 23,000 short tons of finished fluorspar were produced in 1941 compared with 21,000 tons in 1940. Of the county total in 1941, the C. R. Babb, Ellis, Mineral Ridge, and Nancy Hanks mines and the jig plant reclaiming fluorspar from Klondike tailings supplied about 91 percent.

Output at the C. R. Babb and Ellis mines of the Kentucky Fluor Spar Co. was 25 and 27 percent, respectively, greater than in 1940. The company also made a small production at the Wright mine. The shaft at the C. R. Babb mine was sunk 100 feet, making a total depth of 450 feet, where levels are being driven along the vein; the power plant at this mine was improved and enlarged. The lease on the Wright mine was acquired by C. W. Haynes, who sank a 50-foot shaft and mined a small tonnage of mixed fluorspar-barite ore.

Production at the Nancy Hanks mine, operated by the Haynes Fluorspar Co., was 17 percent less than in 1940; sales, however, were 11 percent greater.

The Mineral Ridge Fluorspar Co. produced and shipped fluorspar from the Mineral Ridge mine in 1941.

The Klondike mine made no production in 1941, but the remainder of the mine stock pile was shipped.

Shipments by Butler & Moodie, who operate a jig plant reclaiming fluorspar from Klondike tailings, were considerably larger than in 1940.

In the central Kentucky district a small carload of fluorspar was shipped from the Faircloth mine in Woodford County, near Wilmore.

Nevada.—Shipments of fluorspar from Nevada in 1941—8,967 short tons—exceeded the previous all-time record of 5,803 tons in 1940. Most of the 1941 total went to steel mills and hydrofluoric-acid plants.

The chief producing mine in Nevada in 1941 was the Baxter in Mineral County, operated by V. S. Baxter, where some development work was done. The other active mine was the Daisy in Nye County, operated by J. Irving Crowell, Jr. New equipment was installed at the Daisy mine and mill to increase productive capacity; a flotation unit was also installed but did not operate.

New Mexico.—Production of fluorspar in New Mexico also established a new record in 1941. Shipments from New Mexico, Arizona, and Texas were 19,089 short tons and comprised flotation concentrates (which went chiefly to ceramic and hydrofluoric-acid plants), metallurgical grade (which went chiefly to steel plants), and acid grade (which went to hydrofluoric-acid plants).

Production in New Mexico came from Grant, Hidalgo, Luna, Sierra, and Valencia Counties.

Output at the flotation mill of the Indian Metals Co. at Lordsburg gained 17 percent over 1940. The ore milled came from many properties, but the greater part came from the Howard mine in Luna County and the Shrine mine in Grant County.

The flotation mill of the General Chemical Co. at Deming was operated on a substantially larger scale than in 1940. Most of the ore milled was purchased from producers in New Mexico and Arizona.

The gravity-flotation plant of the Non-Metallic Corporation at Silver City was not operated in 1941.

P. L. Grattan is remodeling his flotation plant at Deming; meanwhile, ore was produced at his mine in Luna County and stock-piled at the mill.

The Howard mine in Luna County, operated by D. F. McCabe, was the largest producer in New Mexico in 1941. About one-third of the output was shipped to steel plants and two-thirds to the flotation plants at Deming and Lordsburg.

The Navajo mines in Valencia County, which have been under development for some time by Navajo Fluorspar Mines, became an important producer in 1941. Production comprised chiefly metallurgical gravel fluorspar shipped to steel mills, but a small quantity of acid grade was shipped to hydrofluoric-acid plants. From July through December 1941 shipments averaged about 700 tons monthly and in January 1942 totaled 1,250 tons. Four tunnels above water level are in active operation on two veins. Although one of the veins is reported to yield acid grade by careful sorting, the output is blended with the lower-grade product from the other vein to make fluxing grade. The mining property is in the Zuni Mountains about 25 miles south of Grants, the shipping point. Ore from the mine is trucked to the mill at Grants, where it is dumped into a hopper that is carried by elevators to a 400-ton bin, which discharges through an automatic feeder to the crusher, rolls, and washer. After washing, the ore is put through screens before going to two 4-cell Bendelari jigs and a smaller Harz jig; some of the fines pass over a concentrating table. The

finished fluorspar is carried by another set of elevators to a bin for loading into cars. Additions to the mill to produce acid-grade fluorspar are contemplated.

Small outputs were made at the Montezuma, Mirabal, and Porter mines, also in Valencia County.

Texas.—In the course of surface prospecting at the Horse Shoe prospect near Hot Wells, Hudspeth County, U. B. Melton produced and shipped a small tonnage of fluorspar to the flotation plant at Deming, N. Mex. It is planned to sink a shaft at the property in 1942.

Utah.—Shipments of fluorspar from Utah were 748 short tons in 1941 compared with 142 tons in 1940, all from the Fred Staats mine in Beaver County. Development work under way at this mine is expected to result in a much larger output in 1942. The Western Fluorite Co. continued development work at its properties in Beaver County and made a trial run at its mill.

Washington.—Crushing, screening, and concentrating equipment was installed at the Mitchem mine in Ferry County, and new stopes were opened in the mine. Two cars of fluorspar were shipped in 1941. This mine was reopened in 1940 and shipped a car of fluorspar, but the report was received too late for inclusion in the statistics for that year; consequently, it has been included in the total for 1941.

IMPORTS AND SHIPMENTS FOR FOREIGN CONSUMPTION

Imports of fluorspar for consumption in the United States during the 9 months January to September 1941 were 7,311 short tons (1,303 tons containing more than 97 percent and 6,008 containing not more than 97 percent calcium fluoride) valued[8] at $73,099. Publication of foreign trade statistics was suspended beginning October 1, 1941. Imports during the year 1940 were 11,873 tons (3,052 containing more than 97 percent and 8,821 containing not more than 97 percent calcium fluoride) valued[8] at $142,931. The value assigned to the foreign fluorspar in 1941 averaged $10 a ton. The cost to consumers in the United States also includes duty, loading charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming plants. The duty on fluorspar containing not more than 97 percent calcium fluoride is $7.50 a short ton and on fluorspar containing more than 97 percent calcium fluoride $3.75 a short ton.

Fluorspar imported for consumption in the United States in 1941 (January to September, inclusive), by countries and customs districts

Country and customs district	Containing more than 97 percent calcium fluoride		Containing not more than 97 percent calcium fluoride		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Mexico:						
Laredo	69	$863			69	$863
Maryland			1,621	$14,704	1,621	14,704
New York	1,234	21,951			1,234	21,951
Philadelphia			1,315	12,777	1,315	12,777
	1,303	22,814	2,936	27,481	4,239	50,295
Spain: Philadelphia			3,070	22,772	3,070	22,772
United Kingdom: Rochester			2	32	2	32
	1,303	22,814	6,008	50,285	7,311	73,099

[8] As defined in sec. 402 of the tariff act of 1930, "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

The foregoing imports for 1941 comprised 82 percent metallurgical gravel fluorspar and 18 percent acid-grade fluorspar. The former was imported from Mexico, Spain, and United Kingdom and the latter from Mexico.

The following table, compiled from data furnished to the Bureau of Mines by importers, shows the quantities of imported fluorspar delivered to consumers in the United States in 1940 and 1941 and the selling price at tidewater (duty paid), irrespective of the year of importation into the United States; it differs from the preceding table, which shows the quantities received in the United States during the first 9 months of 1941. The quantities in the following table are based upon the actual outturn weights ascertained by sworn weighers and represent the weights on which duty was paid and entries were liquidated.

Imported fluorspar delivered to consumers in the United States, 1940–41, by uses

Use	1940			1941		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	9,275	$204,342	$22.03	6,102	$143,863	$23.58
Glass and enamel	11	361	32.82			
Hydrofluoric acid	1,634	44,845	27.44	1,418	38,760	27.33
Miscellaneous	4	160	40.00	69	1,380	20.00
	10,924	249,708	22.86	7,589	184,003	24.25

Producers of fluorspar reported shipments of 12,184 short tons of fluorspar valued at $277,782 in 1941 for foreign consumption compared with 8,482 tons valued at $178,467 in 1940.

Fluorspar reported by producers as shipped from the United States for foreign consumption, 1937–41

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1937	456	$9,091	$19.94	1940	8,482	$178,467	$21.04
1938	788	9,061	11.50	1941	12,184	277,782	22.80
1939	2,976	74,443	25.01				

WORLD PRODUCTION

The following table shows world production of fluorspar by countries from 1937 to 1941, insofar as statistics are available. Because of Government restriction on the publication of statistics for many countries, few figures for 1940 and 1941 are available. However, as the output of steel and aluminum increased greatly in many countries, no doubt world production of fluorspar also gained in 1940 and 1941. Despite the fact that fluorspar is produced in about 20 countries, the United States, Germany, U. S. S. R., United Kingdom, and France normally supply about four-fifths of the world total.

World production of fluorspar, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Argentina [2]	350	1,406	739	597	(3)
Australia:					
New South Wales	55	----------	(3)	(3)	(3)
Queensland	1,410	2,479	20	(3)	(3)
South Australia	----------	----------	----------	(3)	(3)
Victoria	----------	804	----------	(3)	(3)
Canada	136	197	218	(3)	(3)
Chosen	11,000	[4] 34,207	(3)	(3)	(3)
France	51,430	51,920	(3)	(3)	(3)
Germany:					
Anhalt	13,662	10,462	(3)	(3)	(3)
Baden	13,637	21,350	(3)	(3)	(3)
Bavaria	62,455	59,919	(3)	(3)	(3)
Prussia	30,514	22,956	(3)	(3)	(3)
Saxony	8,074	12,063	(3)	(3)	(3)
Thuringia	16,117	22,405	(3)	(3)	(3)
India, British	----------	----------	20	(3)	(3)
Italy	13,385	12,186	(3)	(3)	(3)
Newfoundland (shipments)	8,479	8,944	11,227	14,697	11,581
Norway	1,692	1,676	2,367	(3)	(3)
Southern Rhodesia	----------	156	----------	(3)	(3)
South-West Africa	----------	585	105	(3)	(3)
Spain	4,250	8,596	(3)	(3)	(3)
Tunisia	1,676	2,060	2,473	(3)	(3)
Union of South Africa	3,615	4,736	10,322	7,421	[5] 1,836
U. S. S. R	[6] 70,000	(7)	(3)	(3)	(3)
United Kingdom	42,837	33,866	[5] 17,521	(3)	(3)
United States (shipments)	164,408	72,940	165,806	211,917	290,905
	519,000	456,000	(3)	(3)	(3)

[1] In addition to countries listed, China and Mexico produce fluorspar but data of output are not available.
[2] Railway shipments.
[3] Data not available.
[4] Exports.
[5] January to June, inclusive.
[6] Estimated.
[7] Estimate included in total.

Canada.—The North American Molybdenum Corporation has erected a new head frame at the Madoc property, and the old shaft has been retimbered to its bottom level at 80 feet; plans call for deepening the shaft to 150 feet and establishing a main level at that horizon.[9] The company has started mining operations, and material is being stock-piled for shipment.[10]

China.[11]—The Central China Mining Co. (Sino-Japanese subsidiary of the Japanese semiofficial Central China Development Co.) announced in September 1940 that it would open fluorite mines in northern Chekiang Province. The Japan Iron Mining Co. is stated to have been producing 20,000 tons from mines in that region, but the Central China Mining Co. plans call for an additional production of 200,000 tons annually, the entire output to be exported to Japan.

Chosen.[12]—The Chosen Development Co. is reported to have completed arrangements for the purchase of the Chosen Fluorspar Co., capitalized at approximately $42,192, and for the operation of the mine and sorting mill at Talden, South Chusei Province.

Mexico.[13]—Installation of a 500-ton mill is being completed at the La Azul fluorspar mine, Taxco, Guerrero.

Newfoundland.—Shipments of fluorspar from Newfoundland in 1941 were 12,766 short tons, comprising 4,448 tons of acid grade and 8,313 tons of fluxing grade. Shipments were 16,201 tons in 1940. The decline in shipments was due to labor troubles.

According to Canadian Chemistry and Process Industries:[14]

[9] Northern Miner, May 22, 1941, vol. 27, No. 9, p. 23.
[10] Northern Miner, October 2, 1941, vol. 27, No. 28, p. 5.
[11] Foreign Minerals Quarterly, October 1941, vol. 4, No. 2, p. 13.
[12] Foreign Commerce Weekly, August 16, 1941, vol. 4, No. 7, p. 36.
[13] Engineering and Mining Journal, October 1941, vol. 142, No. 10, p. 92.
[14] Canadian Chemistry and Process Industries, January 1941, vol. 25, No. 1, p. 15.

No attempt has been made to estimate the reserves [of fluorspar] of the [St. Lawrence] district, but the St. Lawrence Corporation of Newfoundland, Ltd., has obtained its production from one vein along a length of 1,200 feet on the 50-foot level and has, among other veins, one with a surface length of 5,500 feet, with widths varying from 2 to 24 feet. Another company, Newfoundland Fluorspar, Ltd., a subsidiary of Aluminum Co. of Canada, Ltd., has been doing exploration and development work for the past 3 years, having drifted for 1,800 feet on the 150-foot level, with crosscuts every 100 feet showing widths from 10 to 35 feet.

Union of South Africa.—Figures on production of fluorspar in the Union of South Africa in 1941 are available for only the first 6 months of the year and totaled 2,024 short tons; shipments during this period were 2,765 tons, of which 1,291 tons were exported to Japan, 280 tons to India, and 43 tons to Northern Rhodesia, and 1,151 tons were sold to local consumers. Production in the year 1940 was 8,180 short tons; shipments were 6,995 tons, of which 4,621 tons were exported to Japan, 103 tons to India, 19 tons to United Kingdom, 6 tons to Southern Rhodesia, and 3 tons to Belgian Congo, and 2,243 tons were sold to local consumers.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. Gibbs [15] has described the mine at Ivigtut, the grades of ore produced, methods of processing and purification, and various uses of cryolite.

A considerable proportion of the cryolite used in the United States is made from fluorspar. According to Frary: [16]

The fluorspar is treated with sulfuric acid to produce hydrofluoric acid, and this is neutralized with the proper amounts of soda ash and aluminum hydrate to produce the cryolite, which is a double fluoride of sodium and aluminum (Na_3AlF_6). The artificial cryolite is quite satisfactory and, in fact, considerably lower in objectionable impurities than the natural cryolite usually used. There would be no serious difficulty in getting along with the artificial product if the supply of natural cryolite from Greenland is shut off.

The chief uses of cryolite are in the metallurgy of aluminum, in the manufacture of glass and enamels, and in insecticides.

Artificial cryolite is manufactured by the Aluminum Ore Co. at East St. Louis, Ill.; the capacity of the plant was enlarged substantially in 1941. A small quantity of artificial cryolite was made in a pilot plant by the Pennsylvania Salt Manufacturing Co. in 1941, and construction of a commercial plant is under consideration.

Imports.—The following table shows imports of cryolite into the United States in 1940 and in the first 9 months of 1941.

Cryolite (natural and artificial) imported for consumption in the United States, 1940–41, by countries

Country	1940		1941 (Jan.-Sept.)	
	Long tons	Value	Long tons	Value
Canada			4	$1,118
France	20	$3,300		
Germany	20	3,713		
Greenland	25,818	1,322,775	14,924	823,850
	25,858	1,329,788	14,928	824,968

[15] Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.
[16] Frary, F. C., Cryolite from Fluorspar. Steel, June 30, 1941, vol. 108, No. 26, p. 4.

FELDSPAR

By Robert W. Metcalf

SUMMARY OUTLINE

SUMMARY

Paralleling record production and shipments of glass containers, both crude and ground feldspar in 1941 again established new production (sales) highs, despite curtailment of new home construction during the last quarter of the year. Sales of crude spar rose to 338,860 long tons, valued at $1,519,456; thus tonnage was 17 percent higher and value 19 percent higher than in 1940. Sales of ground spar in 1941 totaled 354,417 short tons, a 24-percent increase over the 285,713 tons reported for 1940. Total values of crude and ground feldspar in 1941 were 19 and 23 percent, respectively, above 1940 levels; these values, however, were 5 percent less for crude spar and only 0.2 percent greater for ground spar than in 1926, the year of highest realization for crude output.

Salient statistics of the feldspar industry in the United States, 1940–41

	1940	1941	Percent of change in 1941
Crude feldspar:			
Domestic sales.			
Long tons	290,763	338,860	+16.5
Value	$1,271,995	$1,519,456	+19.5
Average per long ton	$4 37	$4.48	+2.5
Imports			
Long tons	12,522	[1] 8,934	
Value	$80,274	[1] $56,731	
Average per long ton	$6.41	[1] $6.35	
Ground feldspar sold by merchant mills			
Short tons	285,713	354,417	+24.0
Value	$3,065,482	$3,782,603	+23.4
Average per short ton	$10 73	$10.67	−.6

[1] Figures cover January to September, inclusive.

Imports of crude feldspar (all from Canada) during the first 9 months of 1941 totaled 8,934 long tons valued at $56,731 compared with 12,522 tons, $80,274, during the full year 1940.

California, Colorado, Maine, New Hampshire, North Carolina, South Dakota, and Wyoming each made a substantially increased output of crude feldspar in 1941. Colorado, New Hampshire, and South

Dakota produced record tonnages, and the North Carolina output reached 100,000 tons for the first time since 1936. Production of ground spar showed large increases in California, New Jersey-Connecticut, and North Carolina-Tennessee, with record tonnages in both Colorado and South Dakota.

DOMESTIC PRODUCTION

In accordance with the usual practice in the industry, crude feldspar is reported in long tons of 2,240 pounds and ground feldspar in short (net) tons of 2,000 pounds, although some leading producers report sales of crude spar in short tons.

Crude feldspar.—Output of crude feldspar reached a new high in 1941, rising to 338,860 long tons or 17 percent above the former record year 1940. The total value ($1,519,456) in 1941 was 19 percent above that in 1940 but 5 percent less than in the record year 1926.

Crude feldspar sold or used by producers in the United States, 1937–41

[Value at mine or nearest shipping point]

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1937	268,532	$1,383,249	$5.15	1940	290,763	$1,271,995	$4.37
1938	196,119	895,081	4.56	1941	338,860	1,519,456	4.48
1939	253,466	1,112,857	4.39				

Crude feldspar sold or used by producers in the United States, 1939–41, by States

[Value at mine or nearest shipping point]

State	1939		1940		1941	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	2,076	$12,655	2,711	$18,254	4,464	$22,490
Colorado	29,995	107,536	34,105	123,514	42,326	147,640
Connecticut	10,033	53,120	24,404	128,348	13,693	92,397
Maine	18,109	74,165	18,390	84,796	22,566	116,610
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Massachusetts	-----	-----	-----	-----	(1)	(1)
New Hampshire	34,414	161,968	38,589	149,031	52,219	200,569
New York	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	76,738	397,631	79,312	426,784	100,016	552,386
Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	48,328	133,893	54,692	157,323	59,015	170,723
Texas	-----	-----	-----	-----	(1)	(1)
Virginia	18,544	100,299	21,705	116,531	(1)	(1)
Wyoming	6,726	25,008	7,833	29,128	11,846	43,484
Undistributed [2]	8,503	46,582	9,022	38,286	32,715	173,157
	253,466	1,112,857	290,763	1,271,995	338,860	1,519,456

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

Texas reported output of crude spar in 1941 for the first time and Massachusetts for the first time since 1910; otherwise, spar was mined during 1941 in the same States that produced in 1940. Three States made record outputs in 1941—South Dakota (59,015 long tons), New

Hampshire (52,219 tons), and Colorado (42,326 tons). North Carolina's output increased about one-fourth; it represented 30 percent of the national total compared with 27 percent in 1940 and 35 percent in 1937. California's output jumped 65 percent to 4,464 tons. Maine, with a production of 22,566 tons, mined more spar than in any year since 1930. The accompanying map (fig. 1) shows the geographical distribution of feldspar mines and grinding plants in the United States.

Average sales realization per long ton for crude feldspar increased about 3 percent to $4.48 in 1941 from $4.37 in 1940. Average values reported for North Carolina, Maine, Virginia, and Connecticut were somewhat higher than in 1940, whereas those for South Dakota and New Hampshire were virtually the same as in 1940. Colorado showed a small decrease. Averages per ton for selected States in both years (1940 in parentheses) follow: North Carolina, $5.52 ($5.38); Maine, $5.17 ($4.61); Virginia, $5.58 ($5.37); South Dakota, $2.89 ($2.88); New Hampshire, $3.84 ($3.86); and Colorado, $3.49 ($3.62).

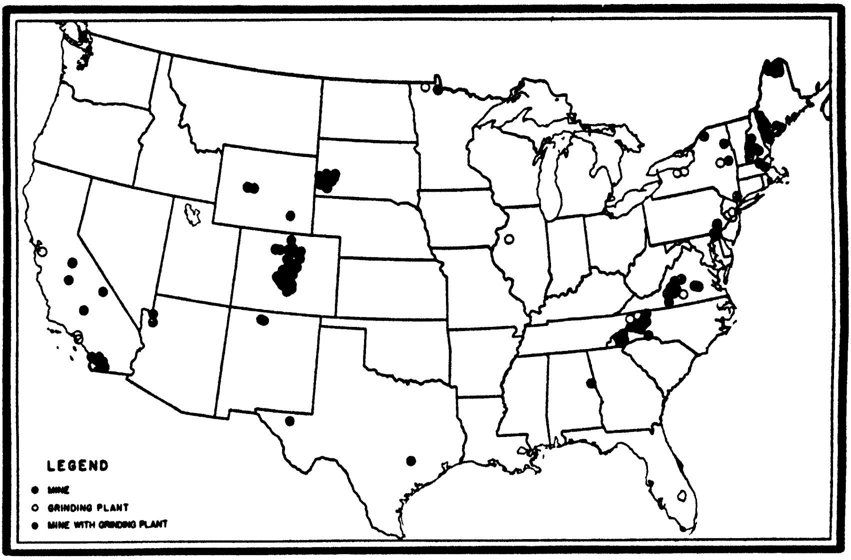

FIGURE 1.—Geographical distribution of feldspar mines and grinding plants in the United States.

Ground feldspar.—Ground feldspar sold by merchant mills in 1941 again established a new high, rising to 354,417 short tons or 24 percent above the former record year 1940. The total value in 1941 ($3,782,603) exceeded slightly (0.2 percent) that reported for 1926, the previous record year for total realization. Colorado and South Dakota together supplied 34 percent of the total ground spar sold or used during 1941 compared with 35 percent in each of the 3 years immediately preceding and 30 percent in 1937. North Carolina-Tennessee, although showing a 22-percent increase over 1940, furnished about the same percentage (27 percent) of the total sales in 1941 as in 1940, compared with about 29 percent in both 1938 and 1939 and 32 percent in 1937. Only 2 percent of the total sales of ground spar from United States mills in 1941 was of Canadian origin, compared with 3 percent in 1940, 4 percent in both 1938 and 1939, and 6 percent in 1937.

Colorado in 1941 rose to first place in output (tons) of ground feldspar and produced more than in any year in its history. The output was 61,141 short tons valued at $387,338 in 1941, or 38 percent more in quantity than in 1940. South Dakota, again with a record tonnage, followed closely with 59,581 tons and $407,454. Tennessee, New Hampshire, and North Carolina ranked next in order. Output from Tennessee and North Carolina combined (95,391 tons) was the largest since 1929. Sales by mills in other States increased from 1940 to 1941, as follows: Arizona, 23 percent; California, 55 percent; Maine, 1 percent; New Jersey and Connecticut combined, 21 percent; New York, 39 percent; and Virginia, 60 percent. Figure 1 shows the distribution of feldspar grinding plants in the United States.

Ground feldspar sold by merchant mills [1] in the United States, 1937–41

Year	Active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1937	31	263,387	$3,187,185	$12.10	15,885	$299,556	$18.86	279,272	$3,486,741
1938	30	206,646	2,314,675	11.20	7,868	151,577	19.26	214,514	2,466,252
1939	31	249,889	2,685,473	10.75	9,305	176,805	19.00	259,194	2,862,278
1940	29	277,612	2,912,470	10.49	8,101	153,012	18.89	285,713	3,065,482
1941	29	347,092	3,646,404	10.51	7,325	136,199	18.59	354,417	3,782,603

[1] Excludes potters or others who grind for consumption in their own plants

The average sales realization for ground feldspar in 1941 declined further to $10.67 per ton from $10.73 in 1940 and $11.04 in 1939. Average values for individual States also were generally slightly less in 1941 than in earlier years—ranging from $6.34 to $17.92 in 1941, $6.38 to $17.96 in 1940, and $6.42 to $18.01 in 1939. Average values for specified States in 1941 follow: Colorado, $6.34; South Dakota, $6.84; California, $11.84; North Carolina-Tennessee, $12.37; Maine, $13.72; and New Jersey and Connecticut combined, $17.92.

Quoted prices on ground feldspar, however, remained unchanged throughout 1941 and into 1942, according to Engineering and Mining Journal Metal and Mineral Markets. As of January 29, 1942, quotations were reported as follows: Potash spar, f. o. b. North Carolina, 200-mesh, white, $17 per ton in bulk; soda spar, $19 per ton; potash spar, f. o. b. Maine, 200-mesh, white, $17 per ton in bulk; North Carolina granular glass spar, 20-mesh, white, f. o. b., $12.50 per ton in bulk; semigranular, $11.75 per ton; Virginia feldspar, No. 1, 230-mesh, $18, 200-mesh, $17; No. 17 glassmakers' spar, $11.75, No. 18 glassmakers' spar, $12.50; and enamelers' spar, $14 to $16 (quotations upon Spruce Pine, N. C., or Keene, N. H., basis).

Ground feldspar sold by merchant mills [1] in the United States, 1939–41, by States

State	1939			1940			1941		
	Active mills	Short tons	Value	Active mills	Short tons	Value	Active mills	Short tons	Value
Arizona	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
California	3	2,082	$27,149	3	2,624	$32,847	3	4,079	$48,292
Colorado	3	41,176	264,153	3	44,260	282,178	3	61,141	387,338
Connecticut				1	(3)	(3)	1	(3)	(3)
Illinois	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
Maine	4	15,246	193,352	3	19,580	255,020	3	19,713	270,434
Minnesota	1	(2)	(2)						
New Hampshire	2	(2)	(2)	2	(2)	(2)	2	(2)	(2)
New Jersey	3	18,727	337,359	3	[3] 21,158	[3] 379,899	3	[3] 25,672	[3] 459,974
New York	4	(2)	(2)	4	(2)	(2)	4	(2)	(2)
North Carolina	3	75,740	920,556	3	78,077	934,702	2	95,391	1,179,577
Tennessee	2			2			2		
South Dakota	2	49,497	340,424	2	54,783	374,024	2	59,581	407,454
Virginia	2	(2)	(2)	1	(2)	(2)	2	(2)	(2)
Undistributed [4]		56,726	779,285		65,231	806,812		88,840	1,029,534
	31	259,194	2,862,278	29	285,713	3,065,482	29	354,417	3,782,603

[1] Excludes potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."
[3] Connecticut included with New Jersey.
[4] Includes items indicated by "(2)"

CONSUMPTION AND USES

Crude feldspar.—Most crude feldspar is sold to merchant mills, which obtain their supply from a number of mines or localities, stockpile and sort it according to grade and source, blend and grind it to required purity and fineness, and sell the ground product. However, some pottery and enamel manufacturers purchase part of their feldspar supply crude and grind it with their own equipment as needed; at least two sanitary-ware manufacturers mine and grind spar for their own use. Makers of soap, cleansers, and sweeping compounds also mine crude feldspar or purchase it—chiefly in New England, Virginia, and North Carolina—and, after grinding or other processing, utilize it as an abrasive in their products. Manufacturers of artificial teeth each year use a small tonnage of carefully selected crude material, which is sold at a substantial premium over No. 1 grade commercial feldspar.

Ground feldspar.—Over 95 percent of the ground feldspar sold by merchant mills in the United States is consumed in ceramics in the manufacture of glass, pottery, and enamel. The quantity consumed in 1941 by the glass industry—principal marketing outlet—totaled 182,878 short tons, an increase of 22 percent over 1940. The proportion of total sales used in glass, however, declined slightly to 51.6 percent from 52.4 percent in 1940 and 53.4 percent in 1939; these figures exclude nepheline syenite, "aplite", and other sources of alumina used in glass-making, the competitive importance of which is increasing steadily. Sales (127,140 tons) to potteries in 1941 increased 22 percent over 1940, and those (34,841 tons) to enamel manufacturers rose 32 percent. Ground spar sold for use in soaps and abrasives—a minor sales outlet for material ground by merchant mills—decreased sharply from 1940 but amounted to nearly twice the 1939 figure. The remainder of the ground spar sold by merchant mills was utilized for purposes not specified and for various ceramic uses other than glass, pottery, or enamel.

Ground feldspar sold by merchant mills in the United States, 1939–41, by uses, in short tons

Use	1939		1940		1941	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	138,336	53.4	149,623	52.4	182,878	51.6
Pottery	87,209	33.7	104,586	36.6	127,140	35.9
Enamel	28,356	10.9	26,420	9.3	34,841	9.8
Other ceramic uses	2,132	.8	649	.2	563	.2
Soaps and abrasives	770	.3	2,682	.9	1,490	.4
Other uses	2,391	.9	1,753	.6	7,505	2.1
	259,194	100.0	285,713	100.0	354,417	100.0

Shipments of ground spar from merchant mills into the principal consuming States were larger in 1941 than in 1940 for all destinations shown separately. Pennsylvania, receiving 54,534 short tons, topped Ohio by a narrow margin and was the largest consuming State; each of these States contributed about 15 percent of the total. Next in order were Illinois (receiving 13 percent), New Jersey (13 percent), Indiana (11 percent), West Virginia (8 percent), New York (5 percent), and Wisconsin, California, and Tennessee combined (9 percent). Shipments to "Other destinations" in 1941 (comprising 11 percent of the total) included sizable tonnages to Louisiana, Maryland (incomplete returns indicate an approximate consumption of 15,000 tons), Michigan, Minnesota, Mississippi, and Oklahoma, and smaller shipments to some 17 other States, District of Columbia, Hawaii, and Canada.

Ground feldspar shipped from merchant mills in the United States, 1940–41, by destinations, in short tons

Destination	1940	1941	Destination	1940	1941
California	7,897	10,444	Tennessee	5,911	9,697
Illinois	32,811	44,573	West Virginia	21,889	29,916
Indiana	28,634	39,620	Wisconsin	6,967	10,517
New Jersey	42,381	44,249	Other destinations [1]	27,721	40,271
New York	13,236	18,326			
Ohio	50,835	52,270		285,713	354,417
Pennsylvania	47,431	54,534			

[1] Arkansas, Colorado, District of Columbia, Hawaii, Kentucky, Louisiana, Maryland (estimated at 15,000 tons in 1941), Michigan, Minnesota, Mississippi, Missouri, Oklahoma, Puerto Rico, South Carolina, and other States for which shipments cannot be segregated. Small shipments to Canada, England, and Mexico also included.

NEPHELINE SYENITE

Industrial interest in nepheline syenite for ceramic purposes continued active, with expanding sales for general pottery use. The glass industry, however, remains the chief consumer of this comparatively recently used raw material. Imports of crude nepheline syenite from Canada into the United States in the first 9 months of 1941 amounted to 23,773 short tons, valued at $74,429; 27,888 tons, valued at $87,162, were received during the entire year 1940. In addition, 718 short tons of ground nepheline syenite (all from Canada), valued at $7,448, were imported during the first 9 months of 1941 compared with 6 tons, valued at $25, in the entire year 1940.

Market quotations on ground nepheline syenite, f. o. b. Rochester, N. Y., as reported in Ceramic Industry, February 1942, were as follows: Glass grade, $12 per (short) ton, and pottery grade, $15.50 per ton.

Research was being continued in the Canadian Bureau of Mines laboratories on the feasibility of treating nepheline syenite for the recovery of alumina and alkalies, the former as a substitute for bauxite in the production of aluminum. Field explorations and drilling of nepheline syenite bodies were undertaken in the Bancroft district in an effort to locate deposits of higher grade and greater uniformity.

A detailed description of nepheline syenite, giving its composition and properties, as well as its advantages in making glass, various types of pottery and enamels, was published at the beginning of 1942.[1]

Baggs [2] has described a number of bodies and glazes containing nepheline syenite. Nogai and Yamabe [3] made studies of special glasses containing large amounts of alumina and magnesia, using nepheline or nepheline syenite as raw materials. Priest [4] discussed the use of nepheline syenite in enamels for cast iron. According to Koenig,[5] the greater fluxing power of nepheline syenite tested in hotel chinaware bodies in place of potash feldspar allowed a lower firing temperature, reduced the amount of principal flux, and reduced or eliminated the use of auxiliary flux. A study of electrical porcelain fluxed with nepheline syenite rather than potash feldspar has indicated an earlier vitrification, about the same firing shrinkage at maturing temperatures, an equal or greater transverse strength, dense well-vitrified bodies, and similar thermal expansion.[6]

APLITE

The mine and nearby mill of Dominion Minerals, Inc., Piney River, Va., producing "aplite" since 1938, were described by Trauffer.[7] "Aplite," a complex silicate rock composed chiefly of the four minerals albite, microcline, sericite, and zoisite, is used as a source of alumina in the manufacture of glass containers and more recently for flat glass and glass fibers. Production has increased steadily each year. New equipment added during 1941 included two additional magnetic separators. An average analysis of "aplite" from Nelson County, Va., supplied by V. V. Kelsey, president, Dominion Minerals, Inc., follows: Silica (SiO_2), 57.75 percent; ferric oxide (Fe_2O_3), 0.80 percent; alumina (Al_2O_3), 24.00 percent; calcia (CaO), 5.60 percent; alkalies (soda, Na_2O, potash, K_2O), 9.15 percent; loss on ignition, 0.70 percent. A new mill in the same locality was erected during 1941 by the Carolina Mineral Co., Erwin, Tenn., subsidiary of the Consolidated Feldspar Corporation; operation began during the early months of 1942.

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[1] Ceramic Industry, A Complete Directory of Ceramic Materials Used in the Manufacture of Enamel, Glass, and Pottery Products, with Details of Their Properties and Functions. Vol. 38, No. 1, January 1942, pp. 36-116 (p. 88).

[2] Baggs, Arthur E., Experiments with Nepheline Syenite Bodies. Bull. Am. Ceram. Soc., vol. 21, No. 4, April 1942, p. 7 (abs)

[3] Nogai, S., and Yamabe, I., Special Glasses Using Nepheline and Talc as Raw Materials: Jour. Japanese Ceram. Assoc , vol. 48, No. 572, 1940, pp. 365-370, Ceram. Abs. (Am Ceram Soc.), vol. 20, No. 8, August 1941, p. 192.

[4] Priest, Harry C , Use of Nepheline Syenite in Enamels for Cast Iron: Jour. Canadian Ceram. Soc., vol. 9, 1940, pp 53-55, Ceram. Abs. (Am. Ceram. Soc.), vol. 20, No. 7, July 1941, p 166.

[5] Koenig, C. G., Nepheline Syenite in Hotel Chinaware Bodies: Jour. Am. Ceram. Soc., vol. 25, No. 3, February 1, 1942, pp. 90-92.

[6] Semple, W. A , Substitution of Nepheline Syenite for Potash Feldspar in Electrical Porcelain: Jour. Canadian Ceram. Soc., vol. 10, 1941, pp. 51-62; Ceram. Abs. (Am. Ceram. Soc.), vol. 21, No. 4, April 1, 1942, p. 85.

[7] Trauffer, W. E , Piney River Plant Processes Virginia Aplite: Mineral Used in Glassmaking: Pit and Quarry, vol. 34, No. 3, September 1941, pp. 44-45

TECHNOLOGIC DEVELOPMENTS

A study of engobe composition with varying contents of kaolin, feldspar, and flint [8] indicated that an increase in the proportion of feldspar increases vitrification and crazing of the glaze whereas low feldspar and flint in the engobes cause dullness in the glaze. Experiments with Italian porcelain bodies have shown an increase in refractoriness and viscosity with use of potash feldspar. Substitution of soda feldspar results in a less-transparent porcelain and higher thermal expansion [9] Introduction of too much alumina into enamels as an opacifier in the form of feldspar is not recommended unless a mat enamel is desired owing to the sudden change from glossy to mat when alumina is used.[10] Mixtures of microcline and plagioclase in porcelain ware were studied.[11] According to Norwegian sources, it has been found that labradorite may be used in making aluminum.[12]

The translucency of whiteware bodies containing feldspar or lepidolite, and those containing mixtures of feldspar and lepidolite, was measured, using a photronic cell and spectrophotometer.[13] Bodies composed of mixtures of feldspar and lepidolite were found to be translucent over a greater range of temperature than those containing feldspar or lepidolite alone, although feldspar bodies of equivalent absorption were more translucent than those using lepidolite alone. The spectrophotometer gives a more complete record of the translucency of porcelain, as it may be used to measure the transmittance of ultraviolet, visible, and infrared light. The use of infrared radiation for dehydration of silicic acid derived from feldspar proved definitely superior to present methods [14] and reduced the analytical time materially. Application of the proposed method to other silicates is suggested.

OTHER DEVELOPMENTS

The grinding mill of the Virginia Feldspar Co., Bedford, Va., now taken over by the Carolina Mineral Co., Erwin, Tenn., subsidiary of the Consolidated Feldspar Corporation, was described in detail during the year. Granular glass spar is shipped.[15] The Seaboard Feldspar Co., whose plant at Brookneal, Va., was destroyed by fire, built a new mill at Bedford,[16] in the heart of the principal Virginia feldspar district; the name of the company also was changed to that of the parent firm—the Clinchfield Sand & Feldspar Co.

Possibilities of commercial deposits of feldspar, mica, beryl, and spodumene in the known pegmatite occurrences in Massachusetts were discussed by Billings.[17]

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[8] Phillipson, E. G , Use of Canadian Clays in Engobes: Jour. Canadian Ceram. Soc., vol. 9, 1940, pp. 50–52; Ceram. Abs (Am Ceram. Soc), vol. 20, No. 7, July 1941, p. 172.

[9] Ficai, C. (Possibility of Substituting Sodium Feldspar for Potassium Feldspar in Porcelain Pastes): Ceramica, vol. 3, 1941, pp. 141–155; Chem. Abs., vol. 35, No. 18, September 20, 1941, p. 6407; Ceram. Abs. (Am. Ceram. Soc.), vol. 20, No. 10, October 1941, p 240.

[10] Vielhaber, L. (Alumina in Enamels): Emailwaren-Ind., vol. 17, Nos 27–28, 1940, pp. 73–74; Ceram. Abs. (Am. Ceram. Soc.), vol 21, No. 2, February 1942, p. 35

[11] Popova, V. T. (Behavior of Mixes of Microcline and Plagioclase Feldspars in Porcelain Studies): Keram. Sbornik, 1940, No. 6, pp. 28–40; Ceram. Abs. (Am. Ceram. Soc.), vol 20, No. 9, September 1941, p 218.

[12] Hamor, William A., Industrial Research in Foreign Countries During 1941: Chem. and Eng. News (Am Chem. Soc.), vol. 20, No. 2, January 25, 1942, pp. 77–109 (p 96).

[13] Arrance, F. C., Use of the Photronic Cell and Spectrophotometer for Measuring Translucency of Whiteware: Jour Am Ceram. Soc., vol. 25, No. 4, February 15, 1942, pp. 116–122, ills. and diags.

[14] Koenig, E. W., Infrared as an Analytical Tool; Dehydration of Silicic Acid Derived from Feldspars: Bull. Am. Ceram. Soc., vol. 20, No. 12, December 1941, pp. 447–450.

[15] Rock Products, Process Feldspar for Glass: Vol. 44, No. 9, September 1941, pp. 52, 57.

[16] Rock Products, vol. 44, No. 11, November 1941, p. 83.

[17] Billings, Marland P., Pegmatites of Massachusetts: Massachusetts Dept. of Public Works and Geol. Survey Coop. Geol. Project Bull. 5, 1941, 22 pp.

A 3-percent increase in freight rates for certain minerals (including feldspar) was approved, to be effective May 15 and until 6 months after the end of the war.[18]

A brief published description of the properties, occurrences, and market classifications of feldspar[19] included lists of producers of crude and ground spar and a selected list of buyers.

Feldspar mining in Canada during 1941 showed little change. Production continued to come chiefly from the two large-scale operators in the Buckingham district, Quebec, and in Bathurst Township, Ontario. The only other concern making important shipments operated near Madawaska in Nipissing district, Ontario, and produced both potash and soda spar.

Large quantities of feldspar are available in the Salem district in southern India, according to a recent survey,[20] but recovery would be difficult. Feldspar is now being mined in Mysore State for the ceramic industry. If the feldspar in the Salem district can be extracted economically, the combined output of the two regions may be adequate for any present or future demand in the neighboring Indian States.

IMPORTS [21]

Feldspar.—Imports of crude feldspar into the United States from January through September 1941 totaled 8,934 long tons valued at $56,731 compared with 12,522 tons valued at $80,274 in the full year 1940. All imports originated in Canada. No receipts of ground feldspar in 1941 were reported.

Feldspar imported for consumption in the United States, 1937–41

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1937	12,956	$91,885			1940	12,522	$80,274		
1938	7,651	56,126			1941 (Jan.–Sept.)	8,934	56,731		
1939	7,460	52,141	2	$54					

Cornwall stone.—Imports for consumption of both unmanufactured and ground Cornwall stone from the United Kingdom, sole source of supply, continued at an active rate during the first 9 months of 1941. Unmanufactured Cornwall stone received during this period totaled 1,931 long tons valued at $20,949 compared with 2,261 tons valued at $20,812 during the full year 1940. Imports of ground Cornwall stone during the first 9 months of 1941 amounted to 182 long tons valued at $2,658 compared with 228 tons valued at $2,758 in the entire year 1940. The average value (foreign market value) per ton for unmanufactured Cornwall stone increased from an average of $9.20 in 1940 to $10.85 in the 1941 period and for ground Cornwall stone from $12.10 to $14.60.

[18] Oil, Paint and Drug Reporter, Freight Rates Increase Approved: Vol. 41, No. 10, March 9, 1942, p. 4.
[19] Metcalf, Robert W., Marketing Feldspar: Bureau of Mines Inf. Circ. 7184, 1941, 13 pp.
[20] Jordan, Curtis C. (American consul, Madras), March 12, 1941: Bureau of Mines Mineral Trade Notes, vol. 12, No. 6, June 20, 1941, p. 23.
[21] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Nominal quotations on Cornwall stone in the spot market at New York during 1941 and continuing into the early months of 1942 were reported in Ceramic Industry at $26 to $30 per long ton.

Cornwall stone imported for consumption in the United States, 1937–41

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1937	1,899	$16,864	323	$4,267	1940	2,261	$20,812	228	$2,758
1938	513	4,976	233	1,797	1941 (Jan.–Sept.)	1,931	20,949	182	2,658
1939	1,684	17,233	348	3,965					

WORLD PRODUCTION

Feldspar sold or used in the United States represents the greater part of the feldspar produced or marketed in the world, according to available data. In addition, a large part—often over half—of the output (shipments) of crude spar from Canadian mines is ground in the United States. Total Canadian shipments in 1941 reached 25,740 metric tons, the highest since 1929 and 32 percent greater than in 1940. Other data available for 1941 indicate a 17-percent rise in United States production to a record output and a jump in Argentine shipments from 1,220 metric tons in 1940 to 2,981 tons in 1941, or 144 percent.

Feldspar produced in Sweden, Norway, and Finland in normal times is exported largely to the United Kingdom, Germany, and other European countries. Production of feldspar, though generally small, is reported from other widely scattered regions, including Brazil, British India, and Australia.

World production of feldspar from 1937 to 1941, insofar as figures are available, is shown in the following table.

World production of feldspar, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Argentina (shipments)	1,346	620	1,051	1,220	2,981
Australia:					
New South Wales [2]	162	178	(3)	(3)	(3)
South Australia [2]	669	502	615	1,072	(3)
Western Australia (exports)	3,031	2,919	3,853	3,561	(3)
Brazil	8,400	(3)	(3)	(3)	(3)
Canada (shipments)	19,365	12,753	11,306	19,464	25,740
Egypt	158	199	74	138	(3)
Finland (exports)	3,232	5,046	5,596	(3)	(3)
France	8,900	(3)	(3)	(3)	(3)
Germany: Bavaria	9,986	10,419	(3)	(3)	(3)
India, British	495	702	501	(3)	(3)
Italy	13,437	13,391	(3)	(3)	(3)
Norway (exports)	32,555	21,761	21,282	(3)	(3)
Rumania	2,587	1,690	(3)	(3)	(3)
Sweden	49,140	45,111	40,792	(3)	(3)
United States (sold or used)	272,842	199,267	257,534	295,430	344,299

[1] In addition to countries listed, feldspar is produced in China (Manchuria) and Czechoslovakia. Official figures of Czechoslovak output are not available, but it is estimated that the annual production is approximately 30,000 metric tons (Stat. Comm. Czechoslovak Ceram. Soc.).
[2] Includes some china stone.
[3] Data not available.

ASBESTOS

By Oliver Bowles and A. C. Petron

SUMMARY OUTLINE

Sales of domestic asbestos, which reached 24,391 short tons in 1941, were the highest in the history of the industry, exceeding those of 1940 by 22 percent. Their value was 8 percent greater than in 1940. Most of the United States production is of the shorter grades of chrysotile, but long-fiber chrysotile obtained in Arizona is attaining increasing importance. During recent years domestic production has supplied only 4 to 8 percent of national requirements, the rest being imported. The ratio of imports to production was approximately the same in 1941 as in recent years.

As for many years, Canada supplied most of the United States imports. Canadian chrysotile is of superior quality and is a satisfactory raw material for most asbestos products. African chrysotile, of which considerable quantities have been imported during recent years, is interchangeable with Canadian asbestos for many uses, and continuation of such imports is highly desirable to supplement the supply of Canadian long fiber, which may be inadequate to meet growing military requirements.

Chrysotile obtained in Rhodesia and, to some extent, in other African localities is very low in iron and therefore is preferred for the manufacture of electrical tapes and other equipment designed for high electrical resistance. Canadian chrysotile contains considerable magnetic iron oxide (magnetite, Fe_3O_4); in consequence, it is less suitable for the more exacting uses than the African fiber. Furthermore, certain varieties of asbestos, such as amosite and crocidolite (blue), which are obtainable in quantity only in Africa, are adapted to specialized uses for which Canadian fibers are less suitable. For instance, amosite can be made into insulation mattresses of exceptionally low weight per cubic foot and hence is well-qualified for use on naval vessels; and blue asbestos is so resistant to chemical action and so strong that it is preferred for acid filters, and as a constituent of asbestos-cement pressure pipe. As these uses are related intimately to the military program, problems of African supplies and possible utilization of asbestos from alternate sources are subjects of constant and careful study.

The Bureau of Mines has made a detailed investigation of essential requirements for the various grades of asbestos fiber and has explored the possibilities of using substitutes for the more critical grades. The problem of substitution involves replacement wherever possible of critical grades with fibers that are abundant and easily accessible, as well as the use of synthetic fibers in place of asbestos. It has been established that the demand for low-iron chrysotile can be met to some extent by the use of fiber-glass products.

The Bureau of Mines and the Geological Survey made a brief field study of the Arizona asbestos area to determine the facilities afforded by that territory for producing asbestos having qualities that would permit its substitution for special grades of low-iron African chrysotile. A confidential report for use of the War Production Board, covering the major problems of asbestos in its relation to the military program, was prepared by the Bureau of Mines under the auspices of the National Research Council.

To supply defense agencies with current data on the asbestos situation, the Bureau of Mines has, since May 1941, conducted a monthly canvass covering consumption and stocks of all important asbestos-products manufacturers. Although consumption increased progressively throughout the year owing to accelerated demands for military equipment, stocks have increased even more. Unless some unforeseen circumstance should arise to paralyze shipping from Africa, no serious difficulty in providing necessary supplies of essential grades is anticipated.

The accompanying table of salient statistics compares 1941 data with those of 1940. Apparent consumption of raw asbestos (sales plus imports minus exports) reached the highest point in 1941 in the history of the industry.

Salient statistics of the asbestos industry in the United States, 1940–41

	1940		1941	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	17,481	(1)	20,144	(1)
Amphibole	1,693	(1)	2,252	(1)
Total produced	19,174	(1)	22,396	(1)
Sold or used by producers:				
Chrysotile	18,672	$664,520	22,439	$707,589
Amphibole	1,388	9,988	1,952	18,164
Total sold or used by producers	20,060	674,508	24,391	725,753
Imports (unmanufactured)	246,613	10,034,433	419,446	17,913,265
Exports (unmanufactured)	4,474	449,105	4,846	325,825
Apparent consumption [2]	262,199	10,259,836	438,991	18,313,193
Exports of asbestos products	(1)	3,473,248	(1)	4,832,948

[1] Figures not available.
[2] Quantity sold or used by producers, plus imports, minus exports.

The following table shows the domestic production of asbestos during recent years.

Asbestos sold or used by producers in the United States, 1937–41, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	11,547	$332,747	532	$11,897	12,079	$344,644
1938	(1)	(1)	(1)	(1)	10,440	247,264
1939	15,043	503,097	416	9,691	15,459	512,788
1940	18,672	664,520	1,388	9,988	20,060	674,508
1941	22,439	707,589	1,952	18,164	24,391	725,753

[1] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.

DOMESTIC INDUSTRY

REVIEW BY STATES

Arizona.—According to reports received by the Bureau of Mines, the production of asbestos in Arizona in 1941 (all from Gila County) was more than twice as great as that in 1940. Sales, also much larger than in 1940, were made by the following companies: Arizona Chrysotile Asbestos Co., Bear Canyon Asbestos Co., Arthur Enders, Roger Q. Kyle, Neighbors & Spencer, Ltd., and Guy Phillips, all of Globe, Ariz.; Fibre & Metal Products, Inc. (formerly Emsco Asbestos Co.), Downey, Calif.; Gladding, McBean Co., 2901 Los Feliz Blvd., Los Angeles, Calif. (formerly owned by Arizona Asbestos Co.); and Johns-Manville Products Corporation, 22 E. 40th St., New York, N. Y. In addition to the firms mentioned, a few small producers made sales to the larger operators.

The Johns-Manville Products Corporation is constructing a new mill at Chrysotile, Ariz., designed in accordance with the results of tests made for several years at Manville, N. J., to determine the best type of equipment for milling Arizona rock and grading the fiber recovered. The output of this mill will add substantially to the supply of Arizona chrysotile, which, because of its low iron content, is especially valuable for certain military manufacturing needs, particularly electrical insulation.

California.—R. B. McIllroy, Lone Pine, produced a small quantity of amphibole asbestos in Inyo County. Kohler & Chase, 26 O'Farrell St., San Francisco, is developing a short-fiber chrysotile asbestos deposit near Monticello, Napa County, about 18 miles north of Napa. Quarry equipment was procured, and a mill was under construction in 1941. A small quantity of fiber has already been produced and sold.

Georgia.—Amphibole asbestos was produced by Philip S. Hoyt near Clayton and by the Powhatan Mining Co. (Woodlawn, Baltimore, Md.) near Dillard, both in Rabun County.

Maryland.—The Todd mine near Pylesville, Harford County, which has for many years produced tremolite asbestos well-suited for making chemical filters, is virtually exhausted.

North Carolina.—Production and sales of amphibole asbestos in North Carolina were over three times as large in 1941 as in 1940. Philip S. Hoyt (Franklin), W. T. Hippey (Micaville), and the Pow-

hatan Mining Co. (Woodlawn, Baltimore, Md.) operated mines in the Micaville-Burnsville area, Yancey County.

Oregon.—Mrs. Flora Winsenberg, Azalea, produced a small tonnage of amphibole asbestos near Rogue River, Jackson County.

Vermont.—Vermont Asbestos Mines Division of the Ruberoid Co., 500 Fifth Avenue, New York City, is the largest producer of asbestos in the United States. An extensive deposit of slip-fiber chrysotile near Eden, Lamoille County, is excavated by open-pit methods, and the rock is milled in a large, well-equipped establishment. Shingle fiber, special brake-lining fibers, and shorter grades were produced in larger quantities in 1941 than in 1940.

LOCATION OF DEPOSITS

The accompanying map (fig. 1) shows the location of chrysotile and amphibole asbestos mines and prospects in the United States. The prospects recorded are confined to those that appear to have commercial importance. More or less promising specimens have been found in many other localities.

The eastern deposits follow closely the highly metamorphosed areas of the Appalachian Mountains. Alteration of ultrabasic rocks (chiefly dunites) resulted—in Vermont and farther north in Quebec, Canada—in the development of chrysotile asbestos, whereas in the southern belt, extending from Pennsylvania to Georgia, the asbestos formed was of the amphibole type, associated with talc, soapstone, greenstone, and other secondary rocks and minerals. Chrysotile is rarely found in the Southeastern States.

The Arizona chrysotile differs entirely in origin from that found in Vermont and Canada. It occurs in bedded veins associated with siliceous dolomites metamorphosed by diabase intrusions. Other western deposits occur generally in highly altered zones of the Rocky Mountain and Coast Ranges.

TRENDS IN CONSUMPTION

The following table shows trends in the asbestos-products industries in the United States during recent years.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1936–41

Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—Manufactured [1]	Asbestos products—Exported [2]	Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—Manufactured [1]	Asbestos products—Exported [2]
1936	250,922	(1)	$2,479,273	1939	255,547	$97,944,735	$3,354,920
1937	316,263	$96,347,570	3,047,078	1940	262,199	(1)	3,473,248
1938	187,150	(1)	2,533,916	1941	438,991	(3)	4,832,948

[1] Figures of Bureau of the Census (collected biennially for odd years) include value of certain gaskets, packing, and similar products in which little asbestos was employed.
[2] Compiled from records of the Department of Commerce.
[3] Data not yet available

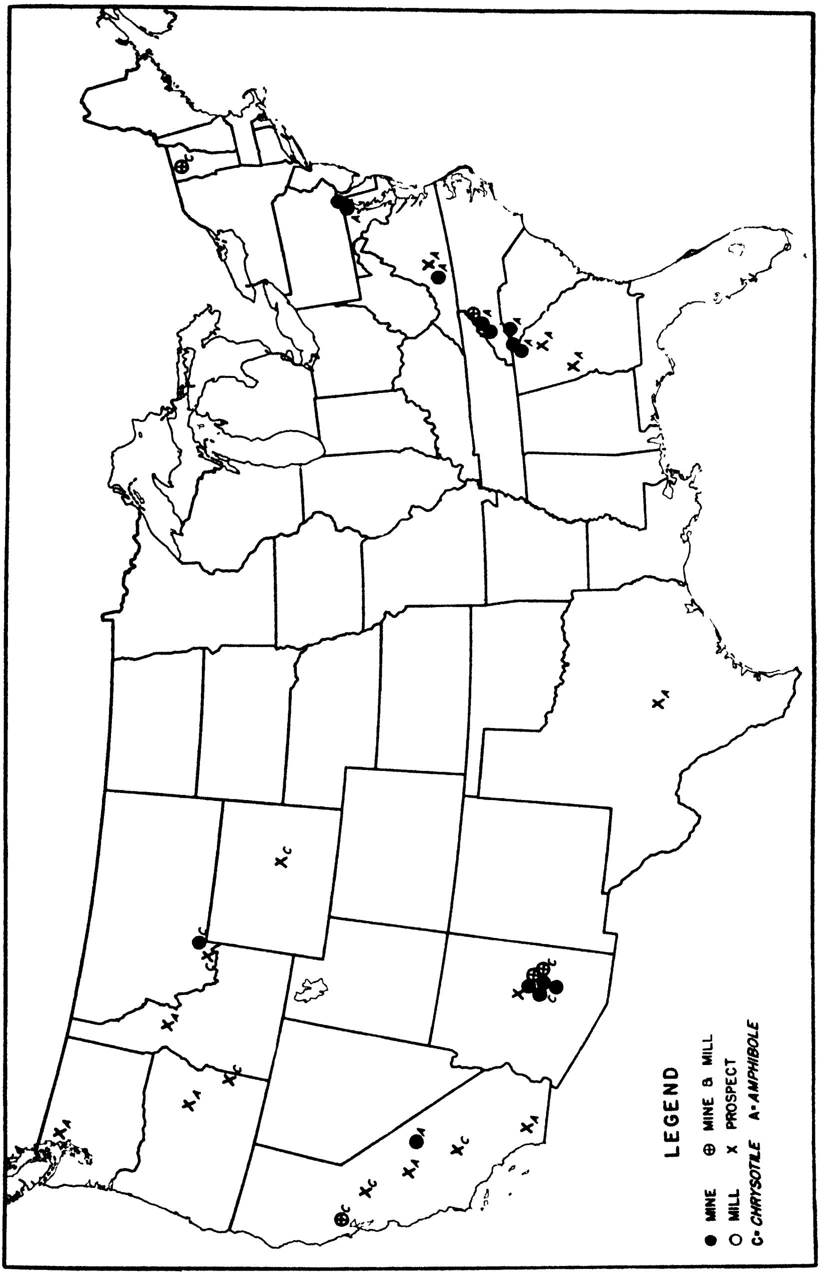

FIGURE 1.—Location of asbestos mines, mills, and prospects in the United States.

The consumption of asbestos is governed to quite an extent by the number of automobiles manufactured because all kinds of automotive transport equipment require brake bands and clutch facings. Activity in building construction also has a decided influence on asbestos sales because asbestos heat-insulation and fireproofing materials, as well as asbestos-cement products (such as shingles, siding, and wallboard), are used extensively. Consumption of asbestos bears a definite relation also to the manufacture of steam engines and similar machinery, because it is used extensively for packings and gaskets, and also for heat insulation in the form of boiler lagging and pipe covering. Figure 2 shows the relationship of asbestos consumption to building construction and the output of automobiles for a period of years.

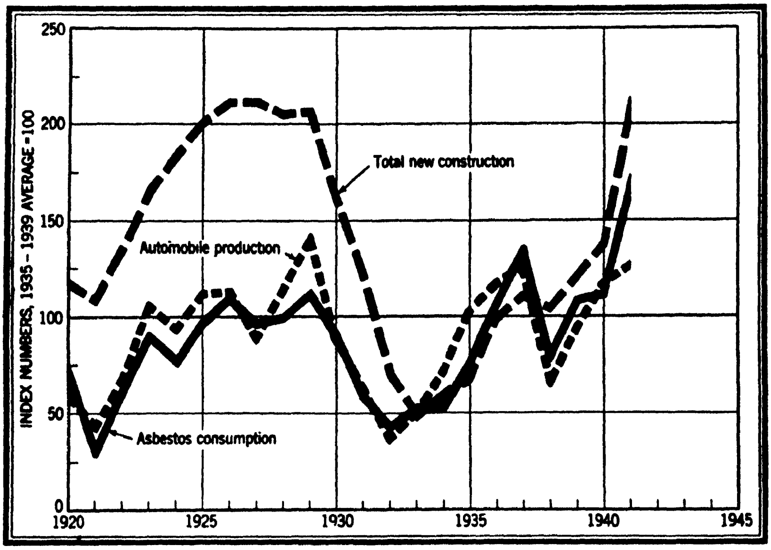

FIGURE 2.—Consumption of asbestos compared with automobile production and construction activity in the United States, 1920–41. Units are reduced to percentages of the 1935–39 average. Statistics on automobiles are from the Bureau of the Census and value of construction from the Bureau of Foreign and Domestic Commerce.

MARKET CONDITIONS

The demand for asbestos attained unparalleled proportions during 1941. The program of national defense created increasing markets for building materials, heat-insulation products, packings, gaskets, and numerous other commodities in which asbestos is an important constituent. The interruption in automobile manufacture was not felt until after the close of the year.

PRICES

Prices for asbestos are quoted upon a short-ton basis from Metal and Mineral Markets, published by the McGraw-Hill Publishing Co., Inc., New York City. Canadian prices are f. o. b. Quebec mines, tax and bags included; Rhodesian, South African, and Russian prices, c. i. f. New York; and Vermont prices, f. o. b. mines, Vermont.

After small advances in shingle, paper, and cement stock during the early months, prices of Canadian fibers were constant from June until the end of 1941, as follows: Crude No. 1, \$700–\$750; Crude No. 2 and sundry crudes, \$150–\$350; spinning fibers, magnesia, and compressed sheet fibers, \$110–\$200; shingle stock, \$57–\$85; paper stock, \$40–\$49; cement stock, \$22–\$30; floats, \$19–\$21; and shorts, \$13–\$17.50. Canadian prices are in United States dollars.

During 1941 African and Russian fibers were quoted only in February, as follows: Rhodesian: Crude No. 1, \$300; Crude No. 2, \$260. South African: Amosite: Grade B 1 (white), \$150; Grade B 3 (dark), \$120; Transvaal Blue: Grade B (long fiber), \$400; Grade S (short fiber), \$150.

Russian quotations were unchanged from 1940 but were purely nominal because no imports of Russian fiber were reported for 1941.

Prices of Vermont shingle and paper stocks were advanced from the 1940 levels in June and other grades in July. Quotations from July to the end of the year 1941 were as follows: Shingle stock, \$57–\$60; paper stock, \$40–\$48; waste, \$30; shorts, \$13–\$26; and floats, \$18.

NEW DEVELOPMENTS

An asbestos deposit that may attain importance is situated 6 kilometers west of Tinaquillo, State of Cojedes, Venezuela. Compania Anonima Minas de Amianto de Tinaquillo, with office in Caracas, has prospected a considerable area by core drilling, and a mill was under construction late in 1941. The fiber is of the chrysotile variety, similar to that in Quebec, Canada. An output of about 6,000 tons of asbestos a year, chiefly of shingle-stock grade, is forecast.

Asbestos-products plants operate in Argentina, Brazil, and Chile. Brazil has deposits of both chrysotile and amphibole. Small exports are reported from Bolivia.

A unique block-caving method has been adopted in several of the large Quebec asbestos mines, with satisfactory results. It is especially advantageous at this time when the industry is operating virtually at capacity to supply British and United States war needs, because underground methods permit almost uninterrupted winter operation whereas activity in open-pit mines is seriously handicapped by the severity of winter weather.

FOREIGN TRADE [1]

The following table shows imports of unmanufactured asbestos into the United States in 1940 and 1941. Total imports in 1941 were considerably larger, both in tonnage and value, than in any previous year. Imports from Africa were at a considerably greater rate than in 1940, a circumstance regarded as highly favorable because much of the African fiber consists of critical grades unobtainable elsewhere.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Asbestos (unmanufactured) imported for consumption in the United States, 1940–41, by countries and classes

Country	Crude (including blue fiber)		Mill fibers		Short fibers [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940								
Africa:								
Union of South Africa	8,752	$835,649					8,752	$835,649
"Other British"	8,462	1,005,844					8,462	1,005,844
Australia	28	7,569					28	7,569
Bolivia	1	118					1	118
Canada	1,572	400,501	81,631	$4,960,416	142,653	$2,721,871	225,856	8,082,788
India, British	1	647					1	647
Italy	17	13,031			170	3,453	187	16,484
Malta, Gozo, Cyprus					3,266	80,057	3,266	80,057
Netherlands Indies	19	1,738					19	1,738
United Kingdom	18	3,239					18	3,239
Venezuela					23	300	23	300
	18,870	2,268,336	81,631	4,960,416	146,112	2,805,681	246,613	10,034,433
1941								
Africa:								
Union of South Africa	21,447	2,075,360					21,447	2,075,360
"Other British"	8,234	1,273,203					8,234	1,273,203
Australia	62	12,769					62	12,769
Bolivia	22	2,504					22	2,504
Brazil					4	142	4	142
Canada	3,362	889,291	163,631	9,401,893	222,648	4,244,947	389,641	14,536,131
India, British	35	12,646					35	12,646
United Kingdom	1	510					1	510
	33,163	4,266,283	163,631	9,401,893	222,652	4,245,089	419,446	17,913,265

[1] Asbestos, n. e. s., containing not over 15 percent foreign matter.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period 1937–41.

Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1937–41

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1937	307,188	$10,470,208	3,004	$253,734
1938	179,490	6,160,602	2,780	288,617
1939	242,561	9,094,538	2,473	218,830
1940	246,613	10,034,433	4,474	449,105
1941	419,446	17,913,265	4,846	325,825

The following table shows exports of asbestos products in 1940 and 1941.

Manufactured asbestos products exported from the United States, 1940–41, by kinds

Product	1940		1941	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded	(1)	$635,425	(1)	$1,150,386
Not molded ... linear feet	638,037	139,146	1,277,562	285,192
Clutch facing ... number	411,958	147,169	1,006,371	364,420
Paper, millboard, and roll board ... short tons	1,231	196,232	1,540	212,157
Pipe covering and cement ... do	1,667	171,558	1,187	136,501
Textiles, yarn, and packing ... do	1,124	1,028,229	1,556	1,356,793
Asbestos roofing ... squares	70,505	413,735	82,149	334,246
Other asbestos manufactures, except roofing ... short tons	2,956	515,769	4,431	679,466
Magnesia and manufactures ... do	1,373	225,985	2,149	313,787

[1] Quantity not recorded.

WORLD PRODUCTION

The following table shows world production of asbestos, by countries, from 1937 to 1941, insofar as figures are available.

World production of asbestos, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Argentina	----	----	110	150	(2)
Australia.					
South Australia	123	49	46	119	(2)
Tasmania	2	4	----	----	(2)
Western Australia	43	123	279	364	(2)
Bolivia	21	21	[3] 2	[3] 71	[3] 211
Brazil	----	120	45	500	[3] 13
Canada [4]	371,967	262,894	330,642	313,504	(2)
China	(2)	(2)	(2)	100	(2)
Chosen	70	(2)	(2)	(2)	(2)
Cyprus (exports)	11,892	5,668	9,970	9,652	(2)
Finland [5]	7,260	(2)	(2)	(2)	(2)
France	250	(2)	(2)	(2)	(2)
Greece	2	85	(2)	(2)	(2)
India, British	102	90	266	(2)	(2)
Indochina	5	----	(2)	(2)	(2)
Italy	6,393	6,860	(2)	(2)	(2)
Japan (approximate)	1,000	1,000	1,000	1,000	(2)
Kenya Colony	----	5	(2)	(2)	(2)
New Zealand	(2)	(2)	(2)	3	(2)
Southern Rhodesia	51,722	53,352	52,900	[6] 22,127	(2)
Swaziland	----	----	7,233	18,873	(2)
Turkey	157	668	88	(2)	(2)
Uganda	----	53	(2)	(2)	(2)
Union of South Africa	25,975	21,025	20,003	24,849	[7] 12,352
U. S. S. R.	125,000	86,000	(2)	(2)	(2)
United States (sold or used by producers)	10,958	9,471	14,024	18,198	22,127
Venezuela	(2)	(2)	(2)	20	(2)

[1] In addition to countries listed, asbestos is produced in Bulgaria, Czechoslovakia, and Madagascar.
[2] Data not available.
[3] Exports.
[4] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1937, 3,611 tons; 1938, 2,975 tons; 1939, 3,535 tons, 1940 and 1941, data not available.
[5] Includes asbestos flour.
[6] January to May, inclusive.
[7] January to June, inclusive.

CANADA

Owing to war conditions, no figures for production of asbestos in Canada during 1941 have been released. Production has probably exceeded by a wide margin all previous records because the greatly expanded asbestos-products industries of the United States have depended chiefly on Canada for supplies of raw materials, and England likewise has drawn large supplies from the Canadian mines. Both open pits and underground mines are worked. During much of the year, the mines were operated 24 hours a day on three shifts, and some of them were on a 7-day-week schedule. The asbestos mills were running virtually at maximum capacity. All grades of asbestos were in demand because sales of all types of asbestos products were heavy Sometimes Canadian producers are overstocked with certain grades that move slowly in the market, but during 1941 the demand was distributed so uniformly over the whole range of products that stocks were low in all categories.

Although no figures are available for 1941, the following table is repeated to show conditions as of 1939 and 1940.

Sales of asbestos in Canada, 1939–40, by grades

Grade	1939			1940		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Crudes	3,121	$938,718	$300.68	2,076	(1)	(1)
Fibers	193,992	12,049,539	62.12	181,890	(1)	(1)
Shorts	167,359	2,870,955	17.15	161,615	(1)	(1)
	364,472	15,859,212	43.51	345,581	$15,620,000	$45.20

[1] Data not available.

AFRICA

Southern Rhodesia.—The largest asbestos mine in Rhodesia is the Shabani, which has been a prolific producer for many years. Its output of chrysotile is supplemented by that of the Birthday, Nil Desperandum, Pangani, and Croft mines. No figures are available for production in 1941, but it was probably larger than in 1940. The following table shows production during recent years.

Asbestos produced in Southern Rhodesia, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	57,014	£840,025	1940 [1]	24,391	£474,617
1938	58,811	1,020,921	1941	(2)	(2)
1939	58,313	1,088,782			

[1] January to May, inclusive.
[2] Data not available.

Union of South Africa.—The Union of South Africa is unique among asbestos producers because it furnishes four varieties of fiber—chrysotile, amosite, crocidolite (blue), and anthophyllite. The last variety is used locally, but the other types have a world-wide market.

Amosite and blue are in such active demand for military needs that the schedule of production of these varieties was expanded during the last 6 months of 1941 and will be enlarged further during 1942.

The following table shows production during recent years, but statistics for 1941 are available for the first 6 months only. Figures for the corresponding period in 1940 are: Transvaal 10,371 and Cape Province 3,095 short tons; total value £234,232.

Asbestos produced in the Union of South Africa, 1937–41, by sources

Year	Short tons				Total value [1]
	Transvaal	Cape Province	Natal	Total	
1937	23,921	4,712	(2)	[2] 28,633	£431,212
1938	16,505	6,484	[2] 187	[2] 23,176	416,401
1939	15,827	6,144	79	22,050	517,535
1940	21,011	6,381	(3)	[3] 27,392	492,125
1941 [4]	10,444	3,172	(3)	[3] 13,616	213,430

[1] Value of local sales plus value of exports.
[2] Small production in Natal in December 1936 and in 1937 included in 1938 figures.
[3] Data for Natal not available.
[4] January to June, inclusive.

The following table shows the tonnage of each variety produced from 1937 to 1940 and in the first 6 months of 1941. Figures for the corresponding 6 months of 1940 are as follows: Amosite (Transvaal) 8,368 short tons; chrysotile (Transvaal) 209; blue (Transvaal) 1,730; blue (Cape) 3,095; and anthophyllite (Transvaal) 64.

Asbestos produced in the Union of South Africa, 1937–41, by varieties and sources, in short tons

Variety and source	1937 [1]	1938 [1]	1939 [2]	1940 [2]	1941 [3]
Amosite (Transvaal)	6,531	8,793	11,299	17,767	9,210
Chrysotile (Transvaal)	16,855	[4] 5,573	[4] 612	646	698
Blue (Transvaal)	535	2,326	3,983	2,520	503
Blue (Cape)	4,712	6,484	6,144	6,381	3,172
Anthophyllite (Transvaal)			12	78	33
	28,633	23,176	22,050	27,392	13,616

[1] Data from Union of South Africa, Department of Mines, Monthly Reports.
[2] Data from Union of South Africa, Department of Mines, Quarterly Reports.
[3] January to June, inclusive.
[4] Includes 187 tons in 1938 and 79 tons in 1939 produced in Natal.

Swaziland.—The Havelock mine in Swaziland near the Transvaal border has become one of the great asbestos mines of the world. Turner & Newall, Ltd., owner of the property, evidently has unbounded confidence in the future of this important chrysotile area because the claims alone cost the company £240,000, and thereafter an additional heavy investment in equipment and development was required before any return was possible. A difficult transportation problem was overcome by means of a 12.6-mile aerial ropeway, with a capacity of 7.5 tons of fiber an hour. Supplies and equipment constitute return loads. It is fortunate that the Havelock mine could attain the status of a major producer at this time and thus offset the great reduction in output of chrysotile in the Transvaal due to depletion of

the once famous Amianthus mine. Production in 1940 was at a rate exceeding 18,000 tons per year, and 1941 production probably was much higher.

CYPRUS

Cyprus normally produces several thousand tons of short-fiber chrysotile a year, and virtually the entire output is exported. However, the island found it rather difficult to carry on foreign trade during 1940 and 1941, and its asbestos-producing activities probably have been curtailed. Exports during recent years are indicated in the following table, but no data are available on production or shipments in 1941.

Asbestos exported from Cyprus, 1937–41

Year	Long tons	Value	Year	Long tons	Value
1937	11,704	£126,371	1940	9,500	(1)
1938	5,578	88,290	1941	(1)	(1)
1939	9,813	(1)			

[1] Data not available.

U. S. S. R.

Large quantities of chrysotile asbestos, similar to that obtained in Canada, are produced in the Bajenova district in the Ural Mountains. A production of 125,000 metric tons was reported for 1937 and of 86,000 tons for 1938, but no data on either production or exports are available for later years. An important asbestos-products-manufacturing industry was established in the country a few years ago, and the factories consume an increasingly large proportion of the asbestos output. Before the war most of the exports were consigned to Germany.

BARITE, WITHERITE, AND BARIUM CHEMICALS

By Bertrand L. Johnson and K. G. Warner [1]

SUMMARY OUTLINE

SUMMARY

New all-time peaks characterized many phases of the domestic barite industry in 1941. All-time highs were reached in the mined production of crude barite (483,391 short tons), an increase of 24 percent over 1940; in the domestic crude barite sold or used by the producers (503,156 tons), an increase of 23 percent; and in the reported consumption of domestic and imported crude barite (490,833 tons), an increase of 21 percent. A new record was also set for the total value of domestic crude barite sold or used by producers in 1941 ($3,134,234), at an average value of $6.23, a little less than that in 1940 ($6.34). Increased demands for crude barite came from the ground (and crushed) barite and barium chemical industries. Imports of crude barite for the 9 months for which data can be published came entirely from Cuba and were far less than for the whole year 1940; the average value also dropped—from $5.59 in 1940 to $5.27 in 1941. Imports of witherite for 9 months were 2,470 short tons; imports for the entire year 1940 were 3,584 tons.

Total sales of barium chemicals were higher both in quantity and value than in recent years. The quantities of lithopone, blanc fixe, artificial barium carbonate, and "other barium chemicals" sold or used by producers in 1941 were all greater than in 1940.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Salient statistics of the barite, witherite, and barium chemical industries in the United States, 1937-41

	1937	1938	1939	1940	1941
Barite:					
Crude:					
Produced short tons	360,877	335,433	365,870	390,462	483,391
Sold or used by producers:					
Short tons	355,888	309,663	383,609	409,353	503,156
Value: [1]					
Total	$2,240,970	$2,004,521	$2,344,103	$2,596,743	$3,134,234
Average	$6.30	$6.47	$6.11	$6 34	$6.23
Imports for consumption:					
Short tons	64,992	24,845	11,588	7,391	[2] 168
Value: [3]					
Total	$327,224	$151,235	$55,985	$41,342	[2] $886
Average	$5.03	$6.09	$4.83	$5.59	[2] $5.27
Apparent new supply [4] short tons	420,880	334,508	395,197	416,744	([5])
Domestic percent	84 6	92 6	97.1	98.2	([5])
Reported consumption (total) short tons	383,982	364,985	391,683	404,388	490,833
Ground (and crushed):					
Sold or used by producers:					
Short tons	129,777	161,422	170,695	184,390	234,877
Value	$2,249,612	$2,786,823	$2,902,973	$3,697,806	$4,606,832
Imports for consumption:					
Short tons	3,313	1,700	1,590	314	-----------
Value	$35,046	$15,466	$14,999	$3,299	-----------
Witherite					
Imports for consumption:					
Short tons	4,556	2,115	3,819	3,584	[2] 2,470
Value	$82,341	$43,568	$64,106	$70,126	[2] $56,789
Barium chemicals:					
Sold or used by producers: [6]					
Short tons	202,408	165,680	183,748	198,201	245,952
Value	$14,992,899	$12,085,012	$12,791,269	$12,868,417	$16,949,120
Imports for consumption:					
Short tons	6,550	4,519	3,205	191	[2] 247
Value	$368,133	$254,874	$172,490	$9,045	[2] $8,427
Exports of lithopone:					
Short tons	2,671	1,734	4,845	14,298	[2] 16,954
Value	$231,622	$153,567	$392,798	$1,112,362	[2] $1,454,520

[1] F. o. b. mine shipping point.
[2] Figures cover January to September, inclusive.
[3] Declared value f. o. b. foreign market.
[4] Barite sold or used by producers plus imports.
[5] Figures not available for publication.
[6] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

BARITE

CRUDE

Production.—The same 10 States produced barite in 1941 as in 1940—Arkansas, California, Colorado, Georgia, Missouri, Nevada, South Carolina, Tennessee, Texas, and Virginia. Mine production in 1941 totaled 483,391 short tons, a 24-percent increase over the 390,462 tons mined in 1940. The location of barite mines and barium products plants in the United States is shown on the accompanying map (fig. 1).

Sales.[2]—A new peak was reached in 1941 (see fig. 2) in the quantity of crude barite sold or used by producers in the United States—503,156 short tons. The total value ($3,134,234) was much higher than in any previous year, and there was an increase of 23 percent in quantity and 21 percent in value over 1940. Missouri continued to lead in sales of crude barite, with sales twice as great as those of the next largest producing State and considerably greater than in 1940.

[2] *See also* Johnson, Bertrand L., Marketing of Barite: Bureau of Mines Inf. Circ. 7149, 1941, 16 pp.

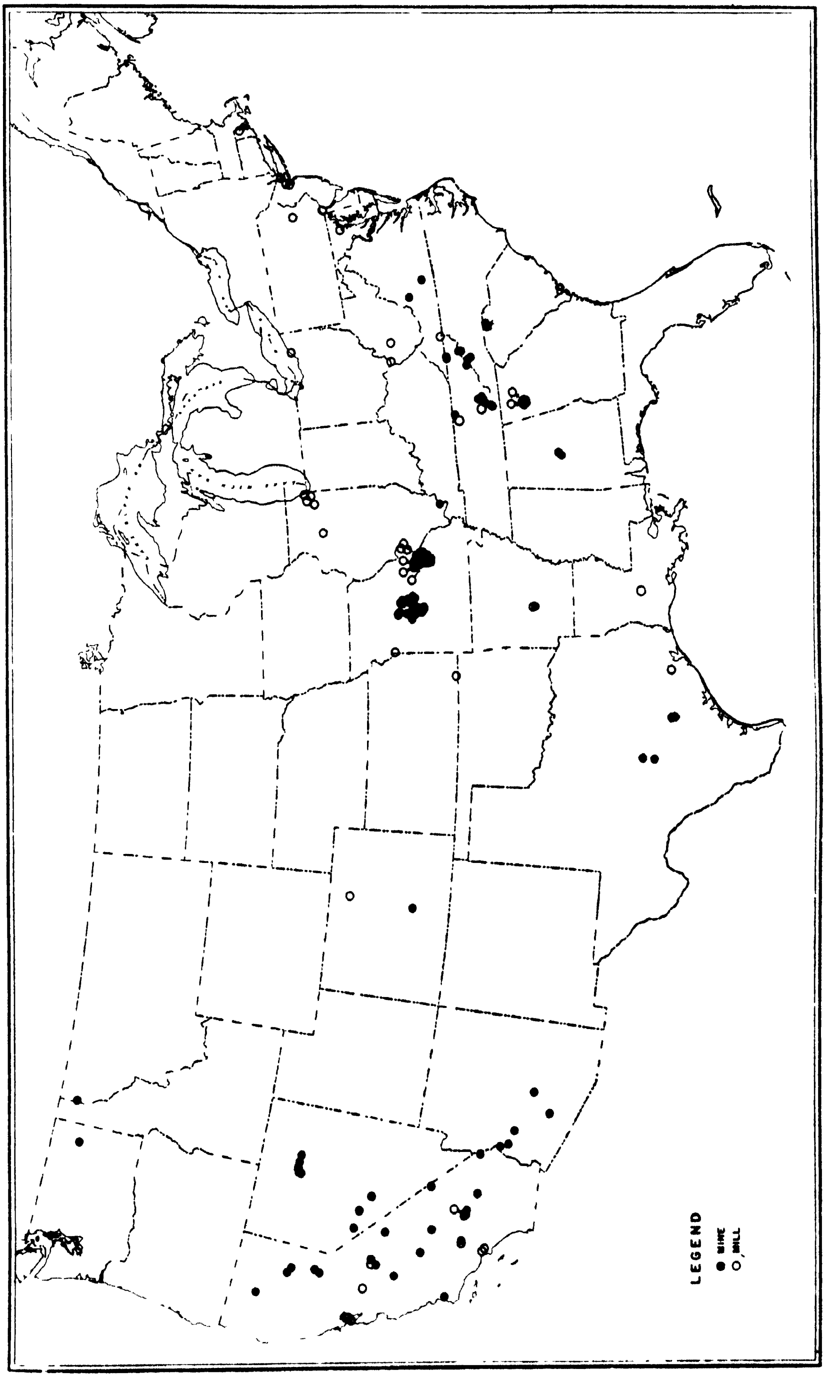

FIGURE 1.—Location of barite mines and barium products plants in the United States.

Tennessee and Georgia were close competitors for second place, Tennessee being apparently slightly in the lead. Both States had large increases over 1940.

Crude barite sold or used by producers in the United States, 1940–41, by States

State	1940		1941	
	Short tons	Value	Short tons	Value
Georgia	92,302	$464,590	104,446	$553,445
Missouri	179,455	1,216,069	212,718	1,337,756
Tennessee	70,767	503,204	104,511	779,565
Other States [1]	66,829	412,880	81,481	463,468
	409,353	2,596,743	503,156	3,134,234

[1] Arkansas, California, Colorado, Nevada, South Carolina, Texas, and Virginia.

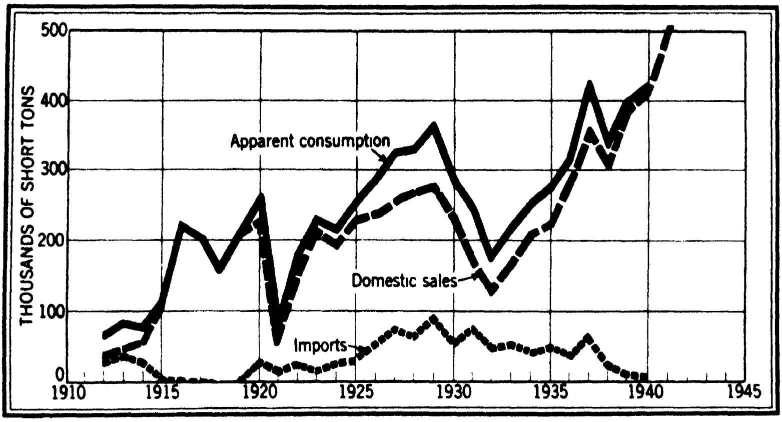

FIGURE 2.—Trends in domestic sales, imports, and apparent consumption of crude barite, 1912–41.

Prices.—The market quotation for crude barite from Georgia, f. o. b. mines, after remaining unchanged at $7 a long ton from 1935 to 1940, increased to $8 a ton in March 1941 and to $9 a ton in April 1942, according to the Engineering and Mining Journal Metal and Mineral Markets.

The price of Missouri crude barite (95 percent $BaSO_4$, less than 1 percent iron) was quoted at $6.25 to $7.00 a short ton throughout 1941, the same as in the later months of 1940, but in April 1942 the quotations rose to $7 to $7.50 a ton. The 93-percent-grade quotations opened in 1941 at $6 to $6.50 a short ton but were lowered slightly to $6 to $6.35 in March 1941 and then in April 1942 were raised to $6.75 to $7.25 a ton.

The average value, f. o. b. mine shipping point, of crude barite for the entire United States declined slightly from $6.34 in 1940 to $6.23 in 1941.

Consumption.—The following tables show the consumption of crude barite by uses and by States.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1937–41, in short tons

Year	In manufacture of— Ground barite	Lithopone	Barium chemicals	Total
1937	148,930	162,681	72,371	383,982
1938	[1] 193,728	117,007	54,250	364,985
1939	[1] 192,112	141,556	58,015	391,683
1940	[1] 200,899	136,885	66,604	404,388
1941	[1] 243,846	153,982	93,005	490,833

[1] Includes some crushed barite.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States in 1941, by States

State	Product manufactured	Plants [1]	Barite used (short tons) [2]
Missouri	Ground barite and chemicals	3	123,921
California	Ground barite, lithopone, and chemicals.	7	41,508
Delaware and New Jersey	do.	4	71,605
Illinois	do	6	59,336
Colorado	Chemicals	1	
Rhode Island	do	1	
West Virginia	do	2	
Kansas	Lithopone	1	
Maryland	do	1	
Pennsylvania	do	1	
Georgia	Ground barite and chemicals	2	194,463
New York	do.	2	
Arkansas	Ground barite	1	
South Carolina	do	1	
Tennessee	do	1	
Texas	do	1	
		35	490,833

[1] A plant producing more than 1 product is counted but once in arriving at State totals.
[2] Includes some crushed barite.

Deposits and technologic developments.—Several articles descriptive of barite deposits and technology, other than those referred to in other parts of this chapter, have appeared in recent months.[3]

Foreign trade.—All of the crude barite imported into the United States in the first 9 months of 1941 came from Cuba. The rate of importation, however, was far less than in 1940, and only 168 tons valued at $886 came into this country from January to September 1941, compared with 7,391 tons valued at $41,342 in the whole year 1940. The average value of the barite imported declined slightly—from $5.59 in 1940 to $5.27 in the first 9 months of 1941. Exports of crude barite from the United States are not separately recorded in the foreign trade statistics.

World production.—Barite production throughout the world, insofar as figures are available, is shown in the accompanying table.

Canadian production of barite was small until mining operations were begun in 1941 at the deposit discovered the preceding year at

[3] Michell, F. B., Barytes and Witherite: Mine and Quarry Eng., vol. 7, No. 2, February 1942, pp. 37–40, 44.
Norman, James, and Lindsey, B. S., Flotation of Barite from Magnet Cove, Ark.: Am. Inst. Min. and Met. Eng., Tech. Pub. 1326, Mining Technol., May 1941, 5 pp.; discussion in Am. Inst. Min. and Met. Eng., Tech. Pub. 1412, Mining Technol., November 1941.
Schallis, Alvin, Barite—United States Industry Expands: Bureau of Mines Mineral Trade Notes, vol. 13, No. 6, December 20, 1941, pp. 20–21.
Zadra, J. B., Fine, M. M., Shelton, S. M., and Johnston, T. L., Concentration of Manganese-Bearing Ore from the Mayfield Property, Van Horn, Tex.: Bureau of Mines Rept. of Investigations 3632, 1942, 18 pp. (A barium-bearing ore.)

Pembroke, Nova Scotia. Production in Canada during 1940 was only 307 metric tons, whereas in 1941, largely because of the above-mentioned operations, it rose to 6,043 metric tons. Most of this came from the Nova Scotia deposit, but a few hundred tons were shipped from a deposit near Golden, British Columbia, most of it to a grinding plant in Montreal and the remainder to oil wells in Turner Valley.[4]

The Pembroke barite deposit in Nova Scotia is owned by the Springer Sturgeon Gold Mines, Ltd., and operated by its subsidiary, Canadian Industrial Minerals, Ltd. Two recent papers by Cameron[5] and Campbell[6] describe the deposit, the barite, the mine and mill operations, and possible markets. The barite is hard and massive and is gray to dark red, replacing iron-bearing calcareous sediments.

World production of barite, 1937–41, by countries, in metric tons[1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
Algeria	2,137	3,069	(2)	(2)	(2)
Argentina	------	------	768	2,680	4,174
Australia:					
New South Wales	268	322	(2)	(2)	(2)
South Australia	2,736	2,909	3,886	3,672	(2)
Tasmania	77	------	------	(2)	(2)
Victoria	71	------	------	(2)	(2)
Brazil (exports)	600	(2)	(2)	(2)	(2)
Canada	------	------	(2)	307	6,043
Chosen	8,400	(2)	(2)	(2)	(2)
Cuba	3,849	------	12,000	16,105	(2)
Egypt	51	20	31	61	(2)
France	19,850	(2)	(2)	(2)	(2)
Germany:					
Austria	855	373	(2)	(2)	(2)
Baden	21,653	36,305	(2)	(2)	(2)
Bavaria	11,832	26,748	(2)	(2)	(2)
Prussia [3]	410,634	401,906	(2)	(2)	(2)
Saxony	432	230	(2)	(2)	(2)
Thuringia	6,790	15,315	(2)	(2)	(2)
Württemburg	192	------	(2)	(2)	(2)
Greece	39,343	34,700	24,055	(2)	(2)
India, British	15,941	8,205	9,404	(2)	(2)
Indochina	45	50	155	185	(2)
Italy	45,202	48,169	(2)	(2)	(2)
Norway	70	------	------	(2)	(2)
Portugal	101	24	(2)	(2)	(2)
Southern Rhodesia	------	91	50	(2)	(2)
Union of South Africa	570	491	439	691	[4] 584
United Kingdom	74,485	77,543	(2)	(2)	(2)
United States	327,380	304,298	331,910	354,219	438,523

[1] In addition to the countries listed, barite is produced in China, Czechoslovakia, Japan, Spain, and U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Official figures which, it is reported, cover only output of mines included under the mining law.
[4] Figures cover January to June, inclusive.

Quarrying operations, and the construction of a 100-ton mill at tidewater at Walton on the Midas Basin arm of the Bay of Fundy, were commenced in February 1941. The mill was put in operation late in May 1941. Ore containing admixed impurities is treated at a washing plant adjacent to the quarry to remove the impurities before it is trucked to the mill over an all-weather road. The first shipment of the ground barite (96.85 percent $BaSO_4$) was made to Trinidad in June 1941. Several other shipments have since been made to Trinidad and one small shipment to Peru. In addition, about 100 tons of ground

[4] Timm, W. B., Industrial Minerals and the War Effort: Canadian Inst. Min. and Met. Bull. 361, May 1942, pp. 181–191.
[5] Cameron, A. E., Barytes Deposit at Pembroke, Hants County, Nova Scotia: Proc. Nova Scotia Inst. Science, Halifax, Nova Scotia, vol. 20, part 3, 1940–41, 1941, pp. 57–63.
[6] Campbell, C. O., Barytes at Pembroke, Hants County, Nova Scotia: Canadian Inst. Min. and Met. Bull. 362, June 1942, pp. 299–310.

barite were marketed in Ontario as a filler in rubber, paints, and varnishes, and a carload of crude ore was shipped to Montreal to determine its suitability for use in the manufacture of various barium compounds. Campbell pointed out that the Canadian market for barite and barium products is small, and to take care of any substantial domestic production it would be necessary to develop export markets; the most promising outlet appears to be in its application as a weighting material in oil-well drilling, in which the color of the barite is said to be of little or no importance. However, leaching of this ore with a 10-percent acid solution is said to remove the iron and to yield a white product.

In 1940 a barite-grinding plant was built at Regla near Habana, Cuba; according to report, most of the Cuban production is shipped to this plant, and in consequence shipments to the United States have dropped. Barite production in Cuba in 1940 is reported to have been 16,105 metric tons compared with 12,000 tons in 1939. Figures for 1941 are not available. Much of the ground barite from the Regla plant is shipped to Trinidad for use in oil-well drilling.

GROUND (AND CRUSHED)

Sales.—The quantity of ground (and crushed) barite sold or used by producers in the United States in 1941 was much larger than the previous all-time high of 1940—234,877 short tons in 1941 compared with 184,390 tons in 1940—and the total sales value likewise showed a marked increase over 1940, rising to $4,606,832. The number of plants producing ground or crushed barite remained at 16, as in 1940 (see accompanying table). By far the predominant use of this material continued to be in well drilling.

Ground (and crushed) barite sold or used by producers in the United States, 1937–41

	1937	1938	1939	1940	1941
Plants	12	14	13	16	16
Short tons	129,777	161,422	170,695	184,390	234,877
Value	$2,249,612	$2,786,823	$2,902,973	$3,697,806	$4,606,832

Ground (and crushed) barite sold or used by producers, 1939–41, by consuming industries

Industry	1939		1940		1941	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling	125,560	74	138,055	75	154,760	66
Paint	9,750	6	11,056	6	31,009	13
Glass	12,586	7	12,697	7	22,615	10
Rubber	3,319	2	4,283	2	9,800	4
Undistributed	19,480	11	18,299	10	16,693	7
	170,695	100	184,390	100	234,877	100

Prices.—Prices quoted from Chemical Industries, New York, for ground barite, carlots, 350-pound barrels, works, ranged from $25.15 to $27.65 a short ton for 1941 compared with $25.15 for 1940.

Foreign trade.—Considerable ground barite is exported from the

United States, but the data regarding these exports are not separately recorded. A few thousand tons are usually imported annually; but in 1940 only 314 short tons were entered, and in the first 9 months of 1941 there were no imports of ground barite.

Ground barite imported for consumption in the United States, 1937–41

[Value at port of shipment]

Year	Short tons	Value	Year	Short tons	Value
1937	3,313	$35,046	1940	314	$3,299
1938	1,700	15,466	1941 (Jan.-Sept.)	----------	----------
1939	1,590	14,999			

WITHERITE

Deposits in North America.—Witherite deposits have been reported in both Canada and the United States, but the only occurrence of present commercial importance is in the latter country. In Canada two occurrences of witherite are known, neither of which is believed to have economic importance. The first is in the old Porcupine mine in the Rabbit Mountain area of the Thunder Bay district of Ontario, about 20 miles west-southwest of Port Arthur on Lake Ontario. The witherite here occurs [7] in a composite vein 1 to 4 feet thick in a fault cutting gently dipping pre-Cambrian black slates and associated diabases. The vein filling consists chiefly of calcite, quartz, fluorite, witherite, galena, sphalerite, pyrite, argentite, and native silver, as well as some chalcopyrite and pyrrhotite. Witherite lenses up to 3 inches thick and 2 feet long have been reported. The other Canadian occurrence is in the recently developed barite deposit at Pembroke, Hants County, Nova Scotia, where Campbell [8] states that a small amount of barium is invariably present in the ore as witherite, and that some samples have shown as high as 1.5 percent witherite. The barite deposit apparently resulted from replacement of a limestone conglomerate of Upper Mississippian age along a zone of brecciation.

In the United States, witherite deposits occur in Alaska, Arizona, California, Kentucky, Montana, Nevada, New Mexico, and Tennessee. The deposits in Kentucky, Nevada, and Tennessee appear to be small and of mineralogic interest only. In Kentucky crystals of witherite have been found in some of the fluorspar-galena veins in the central part of the State.[9] In Nevada only occasional small crystals of witherite have been found. These were in barite veins

[7] Ingall, E. D., Report on Mines and Mining on Lake Superior Geological and Natural History Survey of Canada. Ann Rept (n s), vol 3, part 2, report H, 1887–88, Montreal, 1889, 139 pp

Coste, Eugene, Report on the Mining and Mineral Statistics of Canada for the Year 1887. Geological and Natural History Survey of Canada. Annual Rept (n s.), vol. 3, part 2, report S, 1887–88, Montreal, 1889, 110 pp.

Bowen, N. L, Silver in Thunder Bay District· Ontario Bureau of Mines, vol. 20, part 1, 1911, pp 119–132.

Parsons, A. L, Economic Deposits in Thunder Bay District: Ontario Bureau of Mines, vol. 30, part 4, 1921, 1922, pp. 27–38.

Carter, W. E. H., The Mines of Ontario· Ontario Bureau of Mines, vol 11, 1902, pp 231–298.

Tanton, T L, Fort William and Port Arthur, and Thunder Cape Map Areas, Thunder Bay District, Ontario: Canadian Geol Survey Mem. 167, 1931, 222 pp.

Johnson, Bertrand L., Witherite—Canada: Bureau of Mines Mineral Trade Notes, vol. 14, No. 1, January 20, 1942, pp 28–30.

Hoffman, G. C., Chemical Contributions to the Geology of Canada from the Laboratory of the Survey: Geological and Natural History Survey of Canada, Ann. Rept. (n. s.), vol. 1, report M, 1885, 1886, 29 pp.

[8] Campbell, C. O., Work cited in footnote 6.

[9] Jillson, W. R., The Geology and Mineral Resources of Kentucky· Kentucky Geol. Survey, 1928, 400 pp. (See p. 103.)

Robinson, L. C., Vein Deposits of Central Kentucky: Kentucky Geol. Survey, ser. 6, vol. 41, 1931. (See pp. 28, 48, 118.)

near Argenta, Lander County.[10] In Tennessee a small quantity of witherite is reported as a surface alteration product in a barite vein in Rutherford County.[11] No details are available regarding the New Mexican occurrences reported in Socorro and Dona Ana Counties.[12] The deposits in Alaska, Arizona, and Montana contain considerable witherite, but the extent of each of these deposits is still unknown. According to correspondence from the Alaska Department of Mines dated November 24, 1941, and February 17, 1942, the Alaska deposits, on the shore of Kuiu Island, in southeastern Alaska, consist of a short irregular vein averaging 16 inches thick, scattered small veinlets, and beach pebbles, comprising in all a very small tonnage. In Arizona, witherite forms about 5 percent of the gangue of certain lead veins in the Castle Dome district, Yuma County, according to a letter from F. W. Galbraith of the Arizona Bureau of Mines dated January 20, 1942.[13] The Montana deposits consist of lenses and masses of witherite and irregular lumps up to 2 feet in diameter in solution cavities in Altyn pre-Cambrian limestone just above the plane of the Lewis overthrust fault at Many Glacier in Glacier National Park.[14]

Witherite occurs in California in Mariposa and Shasta Counties. In Mariposa County it is associated with barite in veins cutting sedimentary rocks on the western flank of the Sierra Nevada granite batholith in two localities about 6 miles apart. The northernmost of these, in the Merced River Valley near the El Portal entrance to Yosemite National Park, consists of a group of steeply dipping veins striking north. The veins apparently were formed by replacement of limestone in an isoclinally folded series of Carboniferous sediments by barium-bearing solutions given off by the underlying Jurassic (or Cretaceous) Sierra Nevada granite batholith. This group of veins, reported traceable over a distance of 3 miles, provides a mixture of witherite and barite sold as a flux to glassmakers.[15] This deposit is the only commercial producer of witherite in the United States.

The other locality in Mariposa County is at Devil's Gulch, 6 miles south of El Portal, where a north-striking replacement deposit of barite and witherite in limestone is reported traceable 4,500 feet.[16]

In Shasta County massive witherite is reported on Beegum Creek near Platina.[17]

Production.—The Baroid Sales Division of the National Lead Co., which operates the mine near El Portal, Calif., is the only producer of witherite in the United States. Figures on output are not available for separate publication but are combined with those of barite.

[10] Gianella, V. P., Barite Deposits of Northern Nevada: Am. Inst. Min. and Met Eng., Tech. Pub. 1200, 1940, 6 pp.

[11] Jewell, W. B., Barite, Fluorite, Galena. Sphalerite Veins in Central Tennessee· Paper presented at the Tuscaloosa (Ala.) meeting of the Industrial Minerals Division, Am. Inst. Min. and Met. Eng., November 3, 1939.

[12] Jones, F A., The Mineral Resources of New Mexico· State School of Mines, Mineral Resources Survey of New Mexico, Bull. 1, Socorro, N Mex., 1915, 77 pp.

[13] Johnson, Bertrand L., Witherite—Arizona Bureau of Mines Mineral Trade Notes, vol. 14, No. 2, February 20, 1942, p 27.

[14] Fuller, M. B., An Occurrence of Witherite in the Altyn Limestone at Many Glacier, Mont.: Am. Mineral., vol. 9, No. 7, July 1924, p 154.

[15] Fitch, A. A., Barite and Witherite from near El Portal, Mariposa County, Calif.: Am. Mineral., vol. 16, 1931, pp. 461–468.
Bradley, W. W., Witherite in the Americas· Eng. and Min. Jour., vol. 132, No. 12, December 28, 1931, p. 538. Barite in California: Trans. Am. Inst. Min. and Met. Eng., 1931, pp. 170–176.
Julihn, C. E., and Horton, F. W., Mineral Industries Survey of the United States, California. Mines of the Southern Mother Lode Region. Part II, Tuolumne and Mariposa Counties: Bureau of Mines Bull. 424, 1940, 179 pp.
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Prices.—The price of ground witherite in 1941, according to Chemical Industries, New York, remained constant at $43.00 a ton in carlots, bags, works, for the 90-percent grade. In 1940 prices had ranged between $43 and $47 a ton.

Foreign trade.—Imports into the United States come entirely from England and range from 2,000 to nearly 5,000 tons a year. Imports for the first 9 months of 1941 totaled 2,470 short tons valued at $56,789. Exports of witherite from the United States, if any, are not separately recorded in the foreign trade statistics.

Witherite, crude, unground, imported for consumption in the United States, 1937–41

[Value at port of shipment]

Year	Short tons	Value	Year	Short tons	Value
1937	4,556	$82,341	1940	3,584	$70,126
1938	2,115	43,568	1941 (Jan.–Sept.)	2,470	56,789
1939	3,819	64,106			

BARIUM CHEMICALS

Sales.—Both the total quantity and the value of barium chemicals sold or used by producers in 1941 were much larger than in 1940. Greater quantities of lithopone, blanc fixe, artificial barium carbonate, and "other barium chemicals" were sold. Another new high record was made in sales of artificial barium carbonate (chemically precipitated). Increases in value in 1941 over 1940 were recorded for all the barium chemicals listed in the accompanying table.

Lithopone is used principally in the manufacture of paints, enamels, and lacquers, 75 percent of the total sold or used by producers in 1941 going into those products.

Barium chemicals sold or used by producers in the United States, 1937–41 [1]

Chemical	1937	1938	1939	1940	1941
Lithopone: [2]					
Plants	11	11	11	11	9
Short tons	154,771	125,746	142,759	151,802	176,642
Value	$12,069,790	$9,975,012	$10,461,102	$10,197,897	$12,550,193
Blanc fixe (precipitated barium sulfate):					
Plants	7	7	6	6	6
Short tons	28,250	19,428	18,653	22,247	29,352
Value	$1,614,764	$921,203	$898,198	$1,250,303	$1,806,882
Artificial barium carbonate (chemically precipitated).					
Plants	3	4	5	5	5
Short tons	10,755	9,543	12,478	13,339	17,477
Value	$511,357	$459,901	$617,799	$616,331	$785,486
Other barium chemicals: [3]					
Plants	6	5	7	7	7
Short tons	8,632	10,963	9,858	10,813	22,481
Value	$796,988	$728,896	$814,170	$803,886	$1,806,559
Total barium chemicals:					
Short tons	202,408	165,680	183,748	198,201	245,952
Value	$14,992,899	$12,085,012	$12,791,269	$12,868,417	$16,949,120

[1] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

[2] Does not include cadmium lithopone

[3] Figures cover chemicals, in order of value, as follows: 1937: Chloride, dioxide, sulfide, and hydroxide; 1938: Chloride, dioxide, sulfide, hydroxide, and oxide; 1939 Chloride, dioxide, hydroxide, sulfide, and oxide; 1940: Chloride, dioxide, hydroxide, sulfide, oxide, and nitrate, 1941: Chloride, sulfide, dioxide, hydroxide, nitrate, oxide, and tribarium aluminate.

Lithopone[1] *sold or used by producers, 1939–41, by consuming industries*

Industry	1939		1940		1941	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	113,995	80	117,075	77	132,691	75
Floor coverings and textiles	17,429	12	18,738	13	21,114	12
Rubber	3,189	2	3,387	2	3,547	2
Other	8,146	6	12,602	8	19,290	11
	142,759	100	151,802	100	176,642	100

[1] Does not include cadmium lithopone.

Prices.—Quoted prices for domestic lithopone in 1941 were higher than in 1940, and prices for titanated lithopones likewise rose above the 1940 level. Prices for precipitated barium carbonate in 1941 ranged from $45.00 to $65.00 compared with $45.00 to $62.50 in 1940. There were no changes in barium chloride prices. Barium chlorate prices remained at 45 cents a pound throughout 1941, which was the peak price of 1940. Barium dioxide was quoted at 10 cents a pound throughout 1941 compared with a range of 10 to 12 cents a pound in 1940. There were no changes in barium hydrate prices. Barium nitrate had a wider range of prices in 1941 than in 1940 and rose to a higher price—12½ cents a pound. Blanc fixe quotations showed a marked decrease—$50.00 to $80.00 a ton in 1940 and $35.00 to $46.50 in 1941.

Range of quotations on barium chemicals, 1939–41 [1]

	1939	1940	1941
Lithopone:			
Domestic, ordinary, delivered, bags ...pound..	\$0 03¾–\$0 04⅛	\$0 03⅗	\$0 0385–\$0 04¼
Do ....barrels.....do....	04 – .04⅜	03¾	041 – 04½
High strength, bags ....do....	05¼– .05⅝	05	....
Do ......barrels........do....	.05½– 05⅞	05¼	....
Titanated, bags ....do...	.05¼– 05⅝	.05¼	.05¼– 056
Do....barrels ....do....	.05½– 05⅞	05½	05½– .0585
Barium carbonate, precipitated, 200-pound bags, works........short ton..	52 50 –62 50	\$45 00 –62 50	45 00 –65 00
Barium chlorate, 112-pound kegs, New York pound..	16½– 25	20 – 45	45
Barium chloride, barrels, delivered zone 1..short ton..	77 00 –92 00	77 00 –92 00	77 00 –92 00
Barium dioxide (binoxide or peroxide), 88 percent, drums........pound..	.11 – .12	10 – .12	.10
Barium hydrate, 500-pound barrels........do....	04½– 05½	05½– 07	05½– 07
Barium nitrate, barrels ....do....	.06¾– 10½	.09½– 10½	08½– 12½
Barium sulfate, precipitated (blanc fixe), 400-pound barrels, works [2]........short ton..	40.00 –80 00	50 00 –80 00	35 00 –46.50

[1] Chemical Industries (formerly Chemical Markets), New York (monthly).
[2] Lowest price for pulp grade, highest for high-grade precipitated.

Foreign trade.—Foreign trade figures for barium chemicals are available for publication only for the first 9 months of 1941. During this period the hydroxide and lithopone were the only barium chemicals imported. Both the quantity imported (247 short tons) and the value ($8,418) of the barium hydroxide were much larger than for the entire 12 months of 1940. Only 112 pounds of lithopone were imported from January to September.

Exports of lithopone in the first three quarters of 1941 were greater than in the entire year 1940, both in quantity and total value, and

had a much larger average value. They were greater than in any year since 1922, when exports of barium products were first recorded separately.

Barium chemicals imported for consumption in the United States, 1937–41

[Value at port of shipment]

Year	Lithopone		Barium dioxide		Blanc fixe (precipitated barium sulfate)		Barium carbonate (precipitated)	
	Short tons	Value	Pounds	Value	Short tons	Value	Short tons	Value
1937	5,601	$302,417	229	$34	109	$7,617	30	$848
1938	3,932	207,121	100	13	106	5,102	(1)	32
1939	2,641	130,893	350	51	38	1,891		
1940								
1941 (Jan.-Sept.)	(2)	9						

Year	Barium chloride		Barium nitrate		Barium hydroxide		Barium oxide		Barium compounds (n. e. s.)	
	Short tons	Value	Short tons	Value	Short tons	Value	Pounds	Value	Short tons	Value
1937	315	$13,761	157	$15,836	310	$21,004	298	$161	28	$6,455
1938	69	2,351	126	12,061	236	16,874			50	11,320
1939	39	1,329	100	11,094	360	19,975	22	13	27	7,244
1940			18	1,427	151	3,332			22	4,286
1941 (Jan.-Sept.)					247	8,418				

[1] 110 pounds. [2] 112 pounds.

Lithopone exported from the United States, 1937–41

Year	Short tons	Value	
		Total	Average
1937	2,671	$231,622	$86.72
1938	1,734	153,567	88.56
1939	4,845	392,798	81.07
1940	14,298	$1,112,362	$77.80
1941 (Jan.-Sept.)	16,954	1,454,520	85.79

POTASH

By J. H. Hedges

SUMMARY OUTLINE

The often-repeated claim that development of potash resources within the United States in the brief period since the last war had relieved this country from dependence on foreign supplies was confirmed definitely in 1941, when imports dropped to a few thousand tons and were exceeded by exports drawn from domestic sources and shipped to neighboring countries. Receipts of foreign potash declined sharply in 1940, but imports still were substantial and permitted gradual shifting of the load to American producers. In 1941, although one major plant was strike-bound for 3½ months and its output for the year thereby reduced more than 30 percent, production was greater than ever before, and supplies were adequate to meet a 13-percent rise in consumption.

The United States potash industry is virtually a post-war product of the First World War, born of the realization that complete dependence on foreign supplies invited repetition of the serious wartime shortage that skyrocketed prices of muriate to over $500 a ton in 1915–16. In the intervening 25 years, the combined efforts of Government and private agencies have built up an industry that in 1941 produced almost a million tons of marketable salts containing 525,000 tons of K_2O. Plant additions during the year increased further the capacity to produce refined salts, now estimated to total well over a million tons a year, equivalent to more than 600,000 tons of K_2O. The mines in the Carlsbad area are capable of producing in excess of refinery capacity up to 200,000 tons a year of 20- to 25-percent manure salts that can be employed satisfactorily in compounding some fertilizer mixtures.

The virtual cessation of imports and the increased industrial use of chemical grades were the chief war-induced factors affecting the potash industry. Formerly extensively imported, all potash salts used in the manufacture of black powder, in the Houdry process for the manufacture of aviation gasoline, in the glass industry, and in the heat treatment of aluminum alloys had to be supplied by American producers. The manufacture of potassium chlorate, made by electrolysis of a solution of potassium chloride, was resumed in this country in 1939 in anticipation of interruption of imports. Classed as a material essential for national defense, normal consumption has been 5,000 to 7,000 tons a year. Its principal peacetime use is as the active oxidizing

agent in match heads. Other uses are in flares, fusees, and fireworks for military operations. Production from several plants is reported to be at the rate of about 7,200 tons a year.

Potassium chloride pure enough to be acceptable for industrial and chemical use is made by only two plants, one of which suffered a prolonged strike that reduced output materially. By Government order chemical requirements were given priority over fertilizer needs. As a result, supplies at times were short and open-market offerings were limited, although contract deliveries were well-maintained. The tight spot market brought out some resale offerings at premium prices. Except for these speculative flurries, prices were steady throughout the year.

Except for shipments to Canada, exports were sharply reduced. By Presidential proclamation of January 10, 1941, effective February 3, potash salts were placed under export control. Thereafter export licenses were required for all shipments abroad. Cessation of shipments to Japan, formerly the largest importer of American potash, more than offset increases in other directions and resulted in a sharp drop in total exports.

The potash salts sold were largely refined or processed products derived from bedded deposits in New Mexico, brines in California and Utah, and as a byproduct of manufacturing processes in Maryland. A few tons of cotton-boll ashes were sold in Texas for their potash content. In former years crude alunite has been used in a limited way for fertilizer, but no shipments were reported in 1941. The United States Potash Co., Potash Co. of America, and Union Potash & Chemical Co. mined 82 percent of the total output (K_2O) from salt beds; and the American Potash & Chemical Corporation and Bonneville, Ltd., produced 17 percent from brines. U. S. Industrial Chemicals, Inc., and the North American Cement Corporation accounted for the other 1 percent, which was salvaged from waste products.

Uninterrupted operation of the five principal plants during 1942 should provide ample potash for presumptive needs. Continued increase in use of fertilizers in this country is anticipated but may be checked by shortage of ingredients other than potash needed for preparing the customary mixtures. Explosives manufacture and other war uses doubtless will have first call on nitrates, hence some stringency in supplies for use in fertilizers is not unlikely. Reserves of Chilean nitrate are ample, but supplies from that source are subject to the difficulties and hazards of ocean transportation. New nitrogen plants recently or soon to be completed will increase the domestic supply materially. If the war continues to follow the present pattern, in which bombing plays the leading role, there probably will be enough nitrogen for all uses. Bombs impelled by gravity are much more economical in expenditure of explosives than shells propelled from great guns by enormous charges of powder. Greater use of artillery might result in a shortage of nitrogen for fertilizer and a corresponding reduction in the demand for potash. The needs of other nations that look to the United States for their potash are moderate and can easily be supplied. Except for Canada and Cuba, transportation and distribution are likely to present greater difficulties than supply. The industry appears to be in a favorable position to meet any demands likely to be made upon it in 1942.

Salient statistics of the potash industry in the United States, 1940–41

	1940	1941
Production:		
Potassium salts (merchantable) short tons	658,249	986,458
Approximate equivalent, K_2O do	379,679	524,875
Sales by producers:		
Potassium salts do	677,892	994,843
Approximate equivalent, K_2O do	393,058	531,346
Value at plant	$12,562,050	$17,368,237
Average per ton	$18 53	$17.46
Imports:		
Fertilizer materials short tons	274,473	[1] 36,499
Approximate equivalent, K_2O do	115,241	[1] 10,948
Value	$5,148,852	[1] $753,786
Chemical materials short tons	14,564	[1] 10,173
Approximate equivalent, K_2O do	3,449	[1] 2,075
Value	$2,411,919	[1] $3,491,535
Exports		
Fertilizer materials short tons	93,060	[1] 69,092
Approximate equivalent, K_2O do	55,836	[1] 37,900
Value	$3,141,170	[1] $1,991,727
Chemical materials short tons	14,180	[1] 9,497
Approximate equivalent, K_2O do	7,000	[1] 4,700
Value	$3,096,909	[1] $2,040,956

[1] January to September, inclusive.

PRICES

Prices quoted in schedules issued by producers in 1940 for the 1940–41 fertilizer season were unchanged through May 1941. Price lists for the new season—June 1, 1941, to May 31, 1942—continued the old prices and terms, except for an increase of 1½ cents to 55 cents per unit for 50-percent muriate, produced chiefly by dilution of the standard 60-percent product. As long as refining capacity is adequate there seems to be little excuse for the 50-percent grade, and producers have sought to discourage its use. Wartime shortage of rail and ocean transportation facilities furnishes another potent argument for employing the more concentrated material. Base prices were as follows:

Muriate of potash, 60 percent K_2O minimum	53½ cents per unit K_2O.
Muriate of potash, 50 percent K_2O minimum	55 cents per unit K_2O.
Manure salts, run-of-mine grade	60 cents per unit K_2O.
Sulfate of potash, 90/95 percent K_2SO_4—basis 90 percent K_2SO_4	$36.25 per short ton.
Sulfate of potash-magnesia—minimum 40 percent K_2SO_4, 18.50 percent MgO	$26.00 per short ton.

These prices were ex-vessel at customary Atlantic and Gulf ports and were subject to the following discounts:

On orders placed by June 30, 1941, for delivery during June or in substantially equal monthly quantities from July 1, 1941, to January 31, 1942, a discount of 8 percent.

Upon acceptance of delivery of entire tonnage on order by January 31, 1942, an additional allowance of 4 percent.

On orders placed after June 30, 1941, for delivery at buyer's plant before and including May 31, 1942, list prices applied.

Deductions of 11.2 cents a unit and 8 cents a unit from ex-vessel prices for muriate were offered for purchase f. o. b. Carlsbad and Trona, respectively. This provision was operative throughout the calendar year 1941 and appears to have benefited about one-third of the tonnage sold through saving in freight. Around 40 percent of the f. o. b. shipments were manure salts. The split-discount system inaugurated in 1940 functioned successfully to discourage overorder-

ing and subsequent cancelations, long a disturbing factor in the market and a hazard for producers.

Perhaps the most startling price development was a cut early in June in the base price for manure salts from 60 to 21 cents per unit. The supplementary schedule announcing the price reduction stated by way of explanation—

The very serious scarcity of ships and prohibitive charter rates asked when boats are obtainable combine to make it economically unsound and next to impossible to move this low-grade commodity to Atlantic ports via water transportation at the present time. The outlook for the balance of the season is even less hopeful. For these reasons it is found necessary to announce the above stated price change.

Average prices for the various fertilizer salts for each month are shown in the following table.

Ex-vessel port prices of potash salts in the United States in 1941

Period	Muriate of potash in bulk		Sulfate of potash, 90 percent K_2SO_4, per short ton	Sulfate of potash-magnesia, 40 percent K_2SO_4, per short ton	Manure salts, 25 to 30 percent K_2O, per unit
	60 percent K_2O, per unit	50 percent K_2O, per unit			
January to May, inclusive	$0.535	$0.535	$36.25		$0.60
June	.471	.484	31.90	$22.88	.185
July	.471	.55	36.25	26.00	.21
August to December, inclusive	.535	.55	36.25	26.00	.21

CONSUMPTION AND USES

Potash salts containing approximately 500,000 short tons of K_2O moved into channels for consumption in the United States and its possessions in 1941. About 90 percent was for fertilizer and 10 percent for industrial use. Consumption in industry was around 14,000 tons of K_2O more than in 1940, due mainly to expanded manufacture of black powder and aviation gasoline, in which potash salts are employed. Other uses that have increased as a result of the war include the manufacture of glass and the heat treatment of aluminum alloys. The following table, combining information from various sources, indicates that consumption in the United States and its possessions in 1941 was 504,500 short tons of K_2O—an increase of around 15 percent from 1940. The picture is incomplete, as it is not permitted to disclose foreign trade statistics for the final quarter of 1941.

Sales of primary potash in the United States for consumption and export, 1940–41, in short tons of K_2O

	1940	1941 [1]
Deliveries of potash by member companies reported by American Potash Institute—		
In United States and possessions:		
Agricultural	417,943	435,940
Chemical	37,815	51,962
For export	24,046	26,868
	479,804	514,770
Imports plus sales of nonmember producers	21,737	[1] 32,330
	501,541	[1] 547,100
Total exports	[2] 62,836	[1] 42,600
Actual sales for consumption in the United States	[2] 438,705	[1] 504,500

[1] Figures for imports and exports for 1941 cover January to September, inclusive.
[2] Corrected figure.

PRODUCTION AND SALES

The rising production curve turned more sharply upward in 1941 to record an increase of 50 percent over 1940 in marketable potash salts produced by mines and plants in the United States. The average grade was 53.21 percent potash, and the gain in equivalent potash was 38 percent. Sales 47 percent above 1940 closely approached a million tons of salts containing 531,346 short tons of K_2O, equal to 97 percent of total deliveries for consumption and export and exceeding production by 6,471 tons. The prolonged strike at Trona cost some 30,000 to 40,000 tons of potential K_2O production.

The uneconomic demand for 50-percent muriate continued, despite the fact that this impure material costs the consumer more per unit of potash than the 60-percent grade. Fifty-percent muriate is made by mixing the normal product of the refining processes with run-of-mine salts in suitable proportions or by adjusting the process to leave more impurities in the product. If wartime demand should outstrip refinery capacity, this uneconomic practice might be justified as a temporary expedient; otherwise, it seems inexcusable.

Production of the various grades of salts in 1941 was as follows:

	Short tons
Muriate of potash, 60 percent K_2O minimum	663, 608
Muriate of potash, 50 percent K_2O minimum	85, 398
Manure salts, run-of-mine	154, 979
Sulfate of potash and sulfate of potash-magnesia	82, 473
	986,458

Potassium salts produced, sold, and in producers' stocks in the United States, 1937–41

Year	Production			Sales				Producers' stocks		
	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1937	7	486, 090	284, 497	7	466, 933	266, 938	$9, 019. 534	5	105, 900	55, 620
1938	9	534, 945	316, 951	9	498, 189	286, 437	9, 748, 290	6	158, 540	87. 440
1939	6	546, 757	312, 201	6	634, 014	366, 287	12, 028, 195	5	54, 233	29, 440
1940	7	658, 249	379, 679	7	677, 892	393, 058	12, 562, 050	7	35, 060	16, 370
1941	7	986, 458	524, 875	7	994, 843	531, 346	17, 368, 237	7	26, 374	9, 712

GOVERNMENT ACTIVITIES

On recommendation of the Administrator of Export Control and pursuant to the provisions of section 6 of the act of July 2, 1940, entitled "An Act to Expedite the Strengthening of the National Defense," the President on January 10, 1941, issued a proclamation placing copper, brass, bronze, zinc, nickel, and potash under the export-licensing system. The effective date of the proclamation was February 3, 1941.

The Executive order prescribing regulations governing the exportation of materials designated in the proclamation of January 10 stated that potash should be construed to include the following:

Potassium salts and compounds
- Potassium hydroxide (KOH)
- Potassium carbonate (K_2CO_3)
- Potassium chlorate ($KClO_3$)
- Potassium perchlorate ($KClO_4$)
- Potassium cyanide (KCN)
- Potassium iodide (KI)
- Potassium nitrate (KNO_3)
- Potassium permanganate ($KMnO_4$)
- Potassium acetate ($KC_2H_3O_2$)
- Potassium bicarbonate ($KHCO_3$)
- Potassium bitartrate ($KHC_4H_4O_6$)

Potassic fertilizer materials
- Potassium chloride (KCl)
- Potassium sulfate (K_2SO_4)
- All other potassic fertilizer materials containing 27 percent or more potassium oxide (K_2O) equivalent

All combinations and mixtures of any of the foregoing containing potash salts of 27 percent or more potassium oxide (K_2O) equivalent

The Government-sponsored program for expanding aluminum production to meet wartime needs has again focused attention on alunite deposits in several of the Western States. Attempts during the last war to utilize alunite for the production of potash, with alumina as a byproducts, proved noncommercial under normal conditions, and plants have remained idle since 1918. However, experimentation continued, and several processes were developed. The interest now has shifted to aluminum, but for every ton of aluminum produced from alunite the process will yield about a ton of potassium sulfate. Virtually all alunites contain some sodium, replacing the potassium of the pure mineral. Soda and potash are difficult to separate, hence potassium sulfate from alunite would be contaminated with sodium sulfate to some degree. If proposed plants to make 60,000,000 pounds of aluminum a year from alunite are built they will produce around 30,000 tons a year of potassium sulfate. Both Kalunite, Inc., and the Reynolds Metal Co. are seeking Government funds for aluminum plants. Kalunite controls deposits in Utah and Washington, and Reynolds is reported to be investigating a deposit in Arizona.

REVIEW BY STATES

California.—A strike, called March 14, closed the plant of the American Potash & Chemical Corporation at Trona. Operations were not resumed until July 2, when two-thirds of the workers accepted a company offer and returned to work. Some strikers continued to hold out and picketed the plant for another month before voting to return to work. The settlement was reported to provide a wage scale of 78 cents to $1.20 an hour compared with a previous scale of 67½ cents to $1.05. This company—only producer of potash in the State—is likewise an important producer of borax. Supplies of both potash and borax were seriously affected by the shut-down. Other products of the plant are soda ash, salt cake, sodium-lithium phosphate, and bromide, all extracted from the brine of Searles Lake. The original holdings of the company, which has been operating at Trona contin-

uously since 1915 and was the first American producer of potash in important quantity, comprised placer claims located and patented before enactment of the mineral-leasing law in 1922. Present production is largely from areas leased from the Government.

Maryland.—At the Security plant of the North American Cement Corporation near Hagerstown, impure sulfate of potash was recovered from cement-kiln flue dust. At Baltimore, United States Industral Chemicals, Inc., produced mixed sulfate and chloride as a byproduct of the manufacture of industrial alcohols from molasses. During the acute potash shortage that developed during the World War of 1914–18, a number of industrial plants devised methods for recovering potash salts from plant wastes. However, when imports

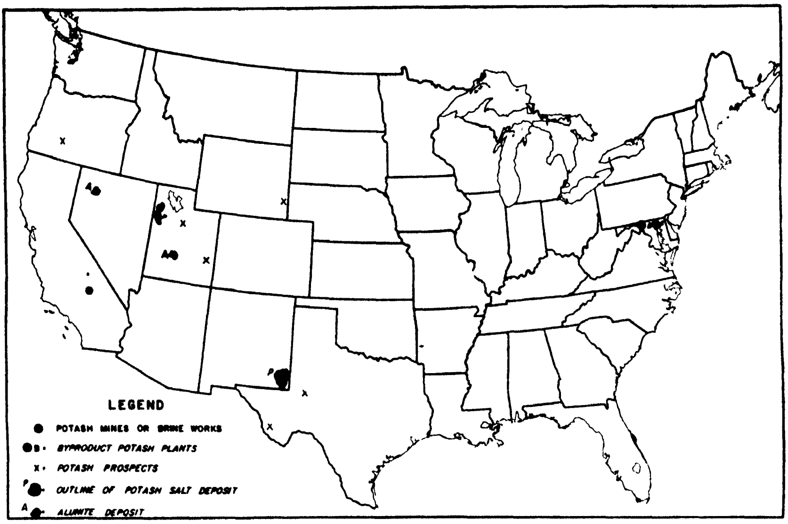

FIGURE 1.—Location of potash mines or brine works, prospects, deposits, and byproduct potash plants in the United States.

were resumed after the war and prices returned to normal, most of these operations became unprofitable and were discontinued. The only exceptions were these two plants in Maryland that each year have contributed several thousand tons to the potash supply.

New Mexico.—The three companies operating in the Carlsbad area mined 2,270,000 tons of ore from rich sylvinite and langbeinite beds at depths ranging from 800 to 1,000 feet. Some run-of-mine ore was shipped to satisfy the demand for manure salts and some was used in mixing to make the 50-percent grade, but the bulk of the raw ore was processed to yield the high-grade salts that constitute a growing percentage of the total output of marketable salts. Production from this field began only 10 years ago with the shipment of a few carloads of manure salts by the United States Potash Co. in 1931, followed a few months later by first shipments from its refinery. The Potash Co. of America was next in the field, beginning to ship manure salts in 1934 and high-grade concentrates in 1935. The growth of these two companies was rapid, and rising output from the district received a further boost with the advent of the Union Potash & Chemical Cor-

poration, which began shipments late in 1940 and completed its first full year of operation in 1941. Although underground conditions are similar at the three properties, operations of the three companies differ markedly in some respects. The refinery of the United States Potash Co. extracts high-purity potassium chloride from sylvinite by solution and fractional crystallization. More recently, a gravity-concentration unit has been added that yields a somewhat lower-grade product. The Potash Co. of America employs a soap flotation process characterized by flotation of the sodium chloride mineral halite and depression of the potassium chloride mineral sylvite. The resulting high-grade product retains the characteristic reddish color of the ore, which is derived from minute impurities. The Union Potash & Chemical Corporation mines both sylvinite (a mixture of sylvite and halite) and langbeinite (K_2SO_4, $2MgSO_4$). The sylvinite is treated by tabling and flotation, using a reagent that floats the sylvite. The langbeinite is washed to remove sodium chloride, centrifuged, and kiln-dried. Some is marketed in this form as sulfate of potash-magnesia, and some is hydrated and used in the manufacture of potassium sulfate by base exchange with potassium chloride. Under carefully controlled conditions, the reaction between the magnesium sulfate of the hydrated langbeinite and potassium chloride brine is rapid and virtually complete. The potassium sulfate produced by this method is high-grade and the byproduct magnesium chloride will be utilized for the production of magnesium metal in a plant soon to be operated by the company near Austin, Tex., where low-cost hydroelectric power is available.

Utah.—Bonneville, Ltd., 540 West Seventh South, Salt Lake City, operating on the salt flats near Wendover in western Utah, doubled the area of its evaporating ponds in preparation for the 1941 season. Earlier difficulties experienced in preventing loss of brine due to leakage from the ponds have been overcome, and improvements in operating the ponds and harvesting the crystallized salts have been introduced. Over 40 miles of collector ditches, fanning out from two pump stations, convey brine to pumps that deliver it to desired points in the ponds. Evaporating ponds extend about 9 miles south from the highway and back on a parallel line to the crytallizing ponds adjacent to the highway. Baffles in the evaporating ponds cause the brine to travel about 30 miles from the point of entry to the crystallizing ponds, where a crystalline mixture of KCl and NaCl is precipitated. The crystallized salts are harvested at the end of the evaporating season and hauled to the mill, where the potash salt is separated by flotation. The muriate produced is about 96 percent KCl. Output in 1941 was nearly double that in 1940 but was less than anticipated because the unusually wet season was unfavorable for this type of operation. Precipitation at Wendover in 1941 was reported to be the heaviest since 1926. The capacity of the present lay-out in a favorable season is believed to be nearly double the quantity produced in 1941. Dry winds, usually prevalent for 6 months or more of the year in this desert region, are the chief agents of rapid evaporation and are more effective than a few extra degrees of temperature. The air immediately above the ponds becomes saturated, and evaporation virtually ceases unless there is enough wind to carry away the vapor.

FOREIGN TRADE [1]

The publication of information regarding exports and imports of all kinds was discontinued October 1. Hence, any data on foreign trade in 1941 contained in this report cover only the 9-month period from January to September.

Imports.—The quantity, average grade, and total declared value of potash salts imported in 1940 and during the first 9 months of 1941, the approximate K_2O equivalent of imports, and the countries from which shipments were made in 1941 are shown in the following tables.

Potash materials imported for consumption in the United States, 1940–41

Material	Approximate equivalent as potash (K_2O) (percent)	1940				1941 (Jan.–Sept.)			
		Short tons	Approximate equivalent as potash (K_2O)		Value	Short tons	Approximate equivalent as potash (K_2O)		Value
			Short tons	Percent of total			Short tons	Percent of total	
Used chiefly in fertilizers:									
Kainite	20 0	36, 175	7, 235	6. 1	$231, 426	-----	-----	-----	-----
Manure salts	31 4	442	139	. 1	4, 432	-----	-----	-----	-----
Muriate (chloride)	56 4	152, 494	86, 007	72. 5	2, 835, 765	13, 671	7, 710	59. 2	$268, 309
Potash-magnesia sulfate	27 0	3. 900	1, 053	. 9	59, 793	-----	-----	-----	-----
Potassium nitrate, crude	40 0	1, 308	523	4	57, 478	-----	-----	-----	-----
Potassium-sodium nitrate mixtures, crude	14 0	55, 016	7, 702	6. 5	1, 366, 131	22, 736	3, 183	24 5	484, 280
Sulfate	50 0	25, 013	12, 507	10 5	592, 318	-----	-----	-----	-----
Other potash fertilizer material [1]	60. 0	125	75	1	1, 509	92	55	4	1, 197
Total fertilizer	-----	274, 473	115, 241	97. 1	5, 148, 852	36, 499	10, 948	84 1	753, 786
Used chiefly in chemical industries									
Bicarbonate	46. 0	14	6		2, 996	-----	-----		-----
Bitartrate									
Argols	20 0	11, 903	2, 381		2, 086, 867	9, 968	1, 994		3, 405, 236
Cream of tartar	25. 0	-----	-----		-----	22	6		14, 427
Carbonate	61 0	9	5		1, 116	4	2		1, 010
Caustic	80. 0	46	37		20, 164	12	10		4, 284
Chlorate and perchlorate	36 0	1, 789	644	2 9	198, 373	123	44	15 9	44, 460
Cyanide	70 0	10	7		6, 967	-----	-----		-----
Ferricyanide (red prussiate)	42. 0	31	13		15, 307	1	(2)		360
Iodide	28 0	(2)	(2)		81	(2)	(2)		14
Nitrate, refined	46 0	616	283		41, 317	(2)	(2)		130
Permanganate	29 0	(2)	(2)		13	13	4		4, 352
All other	50. 0	146	73		38, 718	30	15		17, 262
Total chemical	-----	14, 564	3, 449	2. 9	2, 411, 919	10, 173	2, 075	15 9	3, 491, 535
Grand total	-----	289, 037	118, 690	100 0	7, 560, 771	46, 672	13, 023	100 0	4, 245, 321

[1] Chiefly wood ashes from Canada.
[2] Less than 1 ton.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Potash materials imported for consumption in the United States in 1941 (January–September, inclusive), by countries, in short tons[1]

[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (56.4)	Bitartrate: Argols or wine lees (20)	Bitartrate: Cream of tartar (25)	Caustic (80)	Carbonate (61)	Potassium-sodium nitrate mixtures, crude (14)	Chlorate and perchlorate (36)	All other (55)	Total: Short tons	Total: Value
Algeria		660							660	$238,407
Argentina		3,047							3,047	938,529
Brazil		86							86	26,547
Canada	16	5					1	93	115	4,439
Chile		266	16			22,736	13		23,031	580,250
China					3			(2)	3	766
France							30		30	2,870
Germany							2		2	704
Hong Kong					1				1	278
Japan							61	13	74	38,001
Mexico		35							35	336
Morocco		64							64	8,492
Peru		11							11	2,027
Portugal		2,837							2,837	1,284,036
Spain	13,655	2,957	6						16,618	1,094,038
Sweden				12			5		17	5,123
Switzerland							11		11	3,115
United Kingdom								30	30	17,363
	13,671	9,968	22	12	4	22,736	123	136	46,672	4,245,321

[1] Figures for 1940 in Minerals Yearbook, Review of 1940, p. 1351, should read—Muriate: France, 124,995 tons; Belgium, none. Sulfate: Germany, 195 tons; Netherlands, 305. Potash-magnesia sulfate: Germany, 3,885 tons; Netherlands, 15. Caustic: Germany, 5 tons; France, none. "All other": Italy, 22 tons; Japan, 9. Country totals: Belgium, 748 tons, $31,079; France, 186,308 tons, $3,206,431; Germany, 5,711 tons, $144,421, Italy, 1,479 tons, $291,054; Latvia, 9 tons, $1,880; and Netherlands, 345 tons, $18,854. No change in grand totals.

[2] Less than 1 ton.

Exports.—Effective February 3, 1941, Federal licenses were required for all exports of potash salts. Shipments by producers outside the immediate American market, which is considered to include continental United States, Puerto Rico, Hawaii, Canada, and Cuba, were relatively small, as the need for supplying domestic requirements in the absence of imports left little surplus for export. The bulk of potash fertilizer shipments to countries other than those listed above were drawn from consumers' or speculators' stocks. During the early months of the year Japan continued to receive sizable cargoes, although less than in 1940.

Potash materials exported from the United States, 1937–41

Year	Fertilizer: Short tons	Fertilizer: Value	Chemical: Short tons	Chemical: Value	Year	Fertilizer: Short tons	Fertilizer: Value	Chemical: Short tons	Chemical: Value
1937	103,031	$3,278,895	2,094	$484,450	1940	93,060	$3,141,170	14,180	$3,096,909
1938	84,137	2,599,772	2,616	485,672	1941[1]	69,092	1,991,727	9,497	2,040,956
1939	136,750	4,416,853	3,579	807,987					

[1] January to September, inclusive.

WORLD PRODUCTION

With the exception of the United States, potash-producing countries have issued no official statistics of production or trade since the out-

World production of potash minerals and equivalent K_2O, 1937–41, by countries, in metric tons[1]

[Compiled by B. B. Waldbauer]

Country and mineral [1]	1937 Output	1937 Equivalent K_2O	1938 Output	1938 Equivalent K_2O	1939 Output	1939 Equivalent K_2O	1940 Output	1940 Equivalent K_2O	1941 Output	1941 Equivalent K_2O
North America: United States, potassium salts	440,971	258,090	485,291	287,532	496,007	283,223	597,150	344,437	894,895	476,156
South America: Chile, crude potassium nitrate	([2])	([2])	([2])	([2])	([2])	([2])	62,208	8,585	([2])	([2])
Europe:										
France (Alsace), crude potassium salts	2,883,502	489,801	3,374,811	581,790	([2])	([2])	([2])	([2])	([2])	([2])
Germany, crude potassium salts:										
Carnallite [3]	1,672,417	170,550	1,874,375	1,861,000	([2])	([2])	([2])	([2])	([2])	([2])
Kainite, sylvinite, and hartsalz	12,787,735	1,797,866	14,567,896							
Italy, alunite	3,500	420	2,778	333	([2])	([2])	([2])	([2])	([2])	([2])
Poland, crude potassium salts:										
Kainite	111,357	11,136	120,100	12,010	([2])	([2])	([2])	([2])	([2])	([2])
Sylvite	395,885	87,095	427,200	93,984	([2])	([2])	([2])	([2])	([2])	([2])
Langbeinite	14,241	1,709	19,644	2,358	([2])	([2])	([2])	([2])	([2])	([2])
Spain, crude potassium salts [4]	51,913	([2])	49,572	([2])	([2])	([2])	([2])	([2])	([2])	([2])
U. S. S. R., crude potassium salts	2,400,000	266,000	([2])	[5] 122,000	([2])	([2])	([2])	([2])	([2])	([2])
Asia:										
China, potash	[6] 32	([2])	[6] 14	([2])	[6] 4	([2])	3,317	([2])	([2])	([2])
Chosen, alunite	149,000	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])
India (British), nitrate of potash	[5] 9,000	[5] 4,300	[6] 8,200	[5] 4,000	8,697	4,175	([2])	([2])	([2])	([2])
Palestine, crude potassium salts [7]	36,467	18,234	58,118	29,059	[8] 63,527	31,764	([2])	([2])	([2])	([2])
Africa: Eritrea, niccoli salts [9]	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])
Australia, alunite	339	([2])	445	([2])	([2])	([2])	([2])	([2])	([2])	([2])

[1] In addition to countries listed, Iran is reported to produce a small quantity of potash salts, but statistics of production are not available.
[2] Data not available.
[3] Includes some natural kieserite.
[4] Salable.
[5] Estimated production (Imperial Institute, London).
[6] Exports of potassium carbonate.
[7] Extracted from waters of Dead Sea.
[8] Exports.
[9] Extracted from waters of Red Sea.

break of hostilities in Europe in 1939; hence, there has been a dearth of information on world production of potash in recent years. The appended table represents a compilation of all official statistics on production that have been issued for 1937 to 1941.

FOREIGN DEVELOPMENTS

Australia.—Reports from London state that potash resources in Australia are being explored through the Commonwealth Council for Scientific and Industrial Research. Deposits in the bed of Lake Campion in Western Australia are estimated to contain 2,000,000 tons of alunite, from which 250,000 tons of potassium sulfate could be obtained. Plans are said to include dredging the deposit and constructing a plant to produce 200 tons per week of sulfate or chloride. This would satisfy demands of the Commonwealth, which normally imports around 12,000 tons of potash salts a year. Stocks accumulated in anticipation of interrupted imports are believed to be adequate to last until production can start. The possibility of applying American processes for the production of alumina and aluminum metal from alunite likewise is being studied.

Chile.—Potash production in Chile has been a relatively unimportant offshoot of the sodium nitrate industry. A mixture of sodium and potassium nitrates containing about 14 percent potash found favor in the American market during the last war and earned a profit for the manufacturers. Shipments have continued ever since and in 1941 constituted about two-thirds of the potash fertilizer salts imported. A significant new development is foreshadowed in the recent announcement that the Chilean Government has contracted with the Compañia Salitrera de Tarapacá y Antofagasta (nitrate producers) to organize a company to be known as Sociedad Chilena Explotadora de Potasa to work potash deposits in the Salar de Pintados, in the Province of Tarapacá near Iquique. Plans are said to call for immediate construction of a plant to produce 30,000 tons of refined potash salts a year.

France.—No longer a producer of potash after the loss to Germany of the Alsatian mines in 1940, Unoccupied France is receiving its potash supplies from Spain, doubtless with the consent of German authorities and probably due to transportation difficulties from Alsace. Shipments from Barcelona enter at the port of Cette on the Mediterranean. Rumored plans called for delivery of about 50,000 tons in 1941, but it is believed that less than this amount actually was supplied.

Germany.—The potash mines in Alsace, formerly German-owned but operated by the French Government after the Treaty of Versailles until retaken by the Germans in 1940, are believed to have been returned to their original owners for reincorporation into the German industry. It is not known what disposition has been or will be made of the privately owned Mines de Kali Sainte Thérèse. It is reported that they are being operated by a German company organized for the purpose, but it appears that the French company is being kept alive by the Germans. It is understood that considerable difficulty has been experienced in reestablishing the Alsatian industry. When this operated under French control nearly half the output was ex-

ported through Belgian or Netherlands ports. These outlets now are closed, and transportation in other directions is difficult. Shortages likewise are felt in supplies, equipment, and manpower. Similar problems face the industry in Germany proper. It is believed that little, if any, German potash is being shipped overseas, and it is doubtful whether increased use at home and in the German-dominated countries in an effort to obtain maximum crop production can offset the loss of overseas trade. As previously reported, the big potash companies have attempted to stabilize their operations by branching out into other fields, such as the production and refining of oil, the manufacture of synthetic motor fuels and other byproducts from coal, and the production of magnesium metal and magnesium products.

Under agreements with the German-French Potash Cartel, entered into in 1935 by Spanish producers, Germany delivered several hundred thousand tons to foreign buyers for the account of Spanish producers in 1936, 1937, and 1938, when the Spanish mines were closed by the civil war. The agreements were understood to provide that Spanish producers would be entitled at a later date to indemnification or an increased share in the export market. The Spanish companies are controlled by French and Belgian interests, but both countries are under German domination. There are indications of German interest in rehabilitation of the Spanish mines that resumed production in 1939 but are still far below their maximum pre-war output. If Germany could help to build up Spanish exports, it would serve the double purpose of liquidating indebtedness and conserving foreign markets, insofar as that may be possible.

Palestine.—The chairman of Palestine Potash, Ltd., in his statement to stockholders at the annual meeting November 12, 1941, reported that progress in output and sales had continued without interruption, despite shipping difficulties and delays in obtaining plant and materials brought about by prevailing conditions. From the start of operations, costs decreased steadily until the outbreak of war. Since then there have been certain inevitable increases. £250,000 spent in the 3 years 1938–41 on plant, machinery, and buildings increased output, rationalized production, and maintained for the company its status as what is believed to be the cheapest potash producer in the world. Although profit on trading increased from £199,000 in 1939 to £292,000 in 1940, provision for excess-profit taxes, participation in profits by the Governments of Palestine and Transjordan, and United Kingdom taxation reduced the net profit from £80,254 in 1939 to £15,773 in 1940. Since the outbreak of war, information regarding production and shipments has been considered confidential.

Spain.—Production of potash was resumed in 1939 after the close of the Spanish Civil War, which interrupted operations in 1936. The properties were rehabilitated slowly under difficult conditions. The damage suffered by mines and plants is reported to have been largely from disuse rather than from sabotage. Although no definite information is available regarding the present scale of operations, it is believed that the three operating companies—Minas de Potasa de Suria, Potasas Ibericas S. A., and Union Española de Explosivos—are producing refined salts at the rate of 100,000 to 120,000 tons of K_2O per year. Imports into the United States from Spain in 1941 included 13,655 short tons of muriate. One shipload consigned to

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the United States in December was reported to have been recalled and unloaded at Lisbon. The American market is not particularly attractive to the Spanish exporters because prices are considerably lower than in other markets and high ocean freight and insurance rates leave little profit. Union Española de Explosivos is export selling agent for all three companies, and sales in the United States are handled by the French Potash & Import Co., formed to take over French business when war between France and Germany caused dissolution of the joint sales agency N. V. Potash Export My. Spanish consumption of potash has increased greatly and may now be as much as 40,000 tons of K_2O a year. Spain is supplying potash to Unoccupied France and is reported to have delivered a substantial tonnage to England. It is understood that shipments will be made only on navicerts from Britain and Germany.

MICA

By Paul M. Tyler and K. G. Warner

SUMMARY OUTLINE

SUMMARY

After making new records during 1940, the demand for all kinds of mica continued to increase in the United States until the fourth quarter of 1941, when curtailed manufacture of civilian goods and other conservation measures temporarily offset the growing needs of war industries. Domestic production of sheet mica responded to the increased demand with a 64-percent expansion, and imports increased 31 percent. After Pearl Harbor, estimates of 1942 requirements were boosted to 5,000,000 pounds for strategic block mica alone; but even this high figure, calling for more than doubling normal world production, was viewed with complacency in the expectation that with Continental Europe and Japan out of the market the United States could procure about 50 percent of its expanded needs from British India, 40 percent from Brazil, and 10 percent from other sources (chiefly domestic).

Stocks of splittings at the year end were highly satisfactory, particularly in view of the reduced civilian demand; and, with the possible exception of condenser mica, stocks of block mica in private hands and in Government stock pile were fairly well maintained. Not until Japanese successes in the Pacific threatened to cut off further deliveries from India did fears of an acute shortage of mica become at all general.

The rapidly expanding output of combat equipment created an unprecedented demand for strategic mica, which is defined as block and punch mica of better than heavy-stained quality, free of mineral inclusions (black or red spots, stains, or streaks), cracks, pinholes, cross grains, reeves, and ribs and relatively free of clay staining. It must be hard, clear, reasonably flat, and capable of being evenly and easily split into laminations or sheets of uniform thickness over the entire area, yielding sheets at least 1 by 1 inch in size. The heaviest demand is for 1½- by 2-inch, 2- by 2-inch, and 2- by 3-inch sizes. The principal strategic applications are for making parts of radio transmitting and receiving equipment, aviation magneto condensers and spark plugs, and electrical power development machinery.

To stimulate domestic production, the War Production Board took steps to finance the purchase of strategic mica through the Metals Reserve Co., a subsidiary of the Reconstruction Finance Corporation. Miners were urged to attain maximum output; and, because of the complexities of mica classification, instructions on grading and trimming were prepared.

Splittings, nearly all of which are obtained in India, are also important to the war program. Consumption of splittings, which are used for making a great variety of "built-up" mica products, increased 48 percent in 1941 compared with 1940.

Figures for scrap and ground mica are of lesser significance because they are not regarded as strategic.

The accompanying table of salient statistics portrays outstanding features of the mica industry during the past 5 years.

Salient statistics of the mica industry in the United States, 1937–41

	1937	1938	1939	1940	1941
Domestic mica sold or used by producers:					
Total uncut sheet and punch					
Pounds	1,694,538	939,507	813,708	1,625,437	2,666,453
Value	$285,244	$139,333	$138,963	$291,685	$566,858
Average per pound	$0 17	$0 15	$0 17	$0 18	$0 21
Scrap: [1]					
Short tons	25,196	20,257	24,672	22,386	32,500
Value	$354,737	$256,382	$311,895	$314,565	$442,789
Average per ton	$14 08	$12 66	$12 64	$14 05	$13.62
Total sheet and scrap [1]					
Short tons	26,043	20,727	25,079	23,199	33,833
Value	$639,981	$395,715	$450,858	$606,250	$1,009,647
Total ground [1]					
Short tons	27,245	27,086	30,924	27,984	43,419
Value	$839,812	$924,554	$1,156,333	$1,016,628	$1,532,351
Consumption of splittings [2]					
Pounds	4,347,435	1,667,806	3,423,044	4,918,861	7,297,628
Value	$1,257,645	$612,465	$1,089,683	$1,725,522	$2,832,939
Imports for consumption					
Total uncut sheet and punch					
Pounds	1,004,950	391,125	902,598	1,534,188	2,016,852
Value	$296,235	$113,403	$271,072	$576,565	$1,119,584
Scrap.					
Short tons	6,723	4,450	4,279	3,061	1,251
Value	$36,355	$28,590	$29,493	$22,611	$12,791
Total sheet and scrap					
Short tons	7,226	4,646	4,730	3,828	2,259
Value	$332,590	$141,993	$300,565	$599,176	$1,132,375
Manufactured.					
Short tons	4,113	1,115	1,550	3,860	6,041
Value	$1,735,009	$522,426	$758,745	$1,884,952	$3,282,656
Total imports:					
Short tons	11,339	5,761	6,280	7,688	8,300
Value	$2,067,599	$664,419	$1,059,310	$2,484,128	$4,415,031
Exports (all classes of mica).					
Short tons	1,795	1,772	1,827	903	1,163
Value	$216,858	$183,889	$226,364	$191,550	$280,810

[1] Includes mica recovered from kaolin and mica schists, as follows 1937, 10,536 tons, $149,931; 1938, 6,550 tons, $86,602; 1939, 10,011 tons, $108,899, 1940, 9,674 tons, $138,148, 1941, 15,583 tons, $185,486.

[2] Exclusive of a nominal quantity of splittings produced in the United States and South America.

DOMESTIC PRODUCTION

Sheet mica.—Production of sheet mica in the United States increased sharply in 1941 to an all-time record total of 2,666,453 pounds (valued at $566,858). This compares with a previous record quantity of 2,476,190 pounds worth only $283,832 in 1910. The value of the 1941

output, however, fell short of the record established in 1917 and of 1918. In the former year the output was only 1,276,533 pounds, but it was valued at the high figure of $753,874; the 1,644,200 pounds produced in 1918 were valued at $731,810.

As usual, most of the 1941 output was punch mica. Production of this material increased to 2,342,237 pounds valued at $206,947, representing an increase of 67 percent in quantity and 78 percent in value over that of the preceding year. Although the production of sheet larger than punch showed a smaller percentage increase in quantity, it increased much more in value, the 1941 total being 324,216 pounds worth $359,911 compared with 220,132 pounds and $175,598 in 1940, and only 147,953 pounds and $99,756 in 1939.

About 61 percent of the punch and 54 percent of the larger sheet were produced in North Carolina in 1941. Sales of punch in that State were 70 percent and in the United States as a whole 67 percent greater in 1941 than in 1940. Sheet-mica sales, however, increased only 13 percent in North Carolina, whereas the increase for the country as a whole was 47 percent. New Hampshire, the second-largest producing State, made a large percentage increase in output, as did several of the smaller producing States. In Connecticut, a small reduction in the output of punch was more than offset by a 133-percent increase in yield of sheet.

Mica sold or used by producers in the United States, 1925–41

Year	Sheet mica						Scrap mica and mica recovered from kaolin and schists		Total	
	Uncut punch and circle mica [1]		Uncut mica larger than punch and circle		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1925–29 (average)	1,433,684	$117,702	405,400	$172,679	1,839,084	$290,381	11,687	$215,632	12,607	$506,013
1930–34 (average)	589,668	25,764	153,433	69,930	743,101	95,694	10,869	145,097	11,241	240,791
1935–39 (average)	888,313	46,408	252,411	139,306	1,140,724	185,714	21,986	285,512	22,557	471,226
1937	1,312,900	70,493	381,638	214,751	1,694,538	285,244	25,196	354,737	26,043	639,981
1938	774,121	45,566	165,386	93,767	939,507	139,333	20,257	256,382	20,727	395,715
1939	665,755	39,207	147,953	99,756	813,708	138,963	24,672	311,895	25,079	450,858
1940:										
Connecticut	244,981	14,849	40,709	25,467	285,690	40,316	300	4,900	443	45,216
New Hampshire	167,969	10,747	(2)	(2)	[2] 167,969	[2] 10,747	(2)	(2)	[2] 84	[2] 10,747
North Carolina	848,663	78,214	153,983	139,940	1,002,646	218,154	11,595	173,327	12,096	391,481
Other States [3]	143,692	12,277	[2] 25,440	[2] 10,191	[2] 169,132	[2] 22,468	[2] 10,491	[2] 136,338	[2] 10,576	[2] 158,806
	1,405,305	116,087	220,132	175,598	1,625,437	291,685	22,386	314,565	23,199	606,250
1941:										
Connecticut	157,816	11,135	95,009	118,761	252,825	129,896	201	3,983	327	133,879
New Hampshire	368,794	36,172	26,113	28,932	394,907	65,104	171	3,700	369	68,804
North Carolina	1,440,349	124,355	174,514	194,428	1,614,863	318,783	18,234	268,596	19,041	587,379
Other States [3]	375,278	35,285	28,580	17,790	403,858	53,075	13,894	166,510	14,096	219,585
	2,342,237	206,947	324,216	359,911	2,666,453	566,858	32,500	442,789	33,833	1,009,647

[1] Includes small quantities of splittings in certain years.
[2] "Uncut mica larger than punch and circle" and scrap for New Hampshire included with "Other States."
[3] 1940: Alabama, Arizona, California, Colorado, Georgia, Maine, New Mexico, New York, South Carolina, South Dakota, Vermont, and Virginia, includes also "Uncut mica larger than punch and circle" and scrap for New Hampshire; 1941. Alabama, Arizona, California, Colorado, Georgia, Maine, New Mexico, New York, Pennsylvania, South Carolina, South Dakota, Vermont, Virginia, and Wyoming.

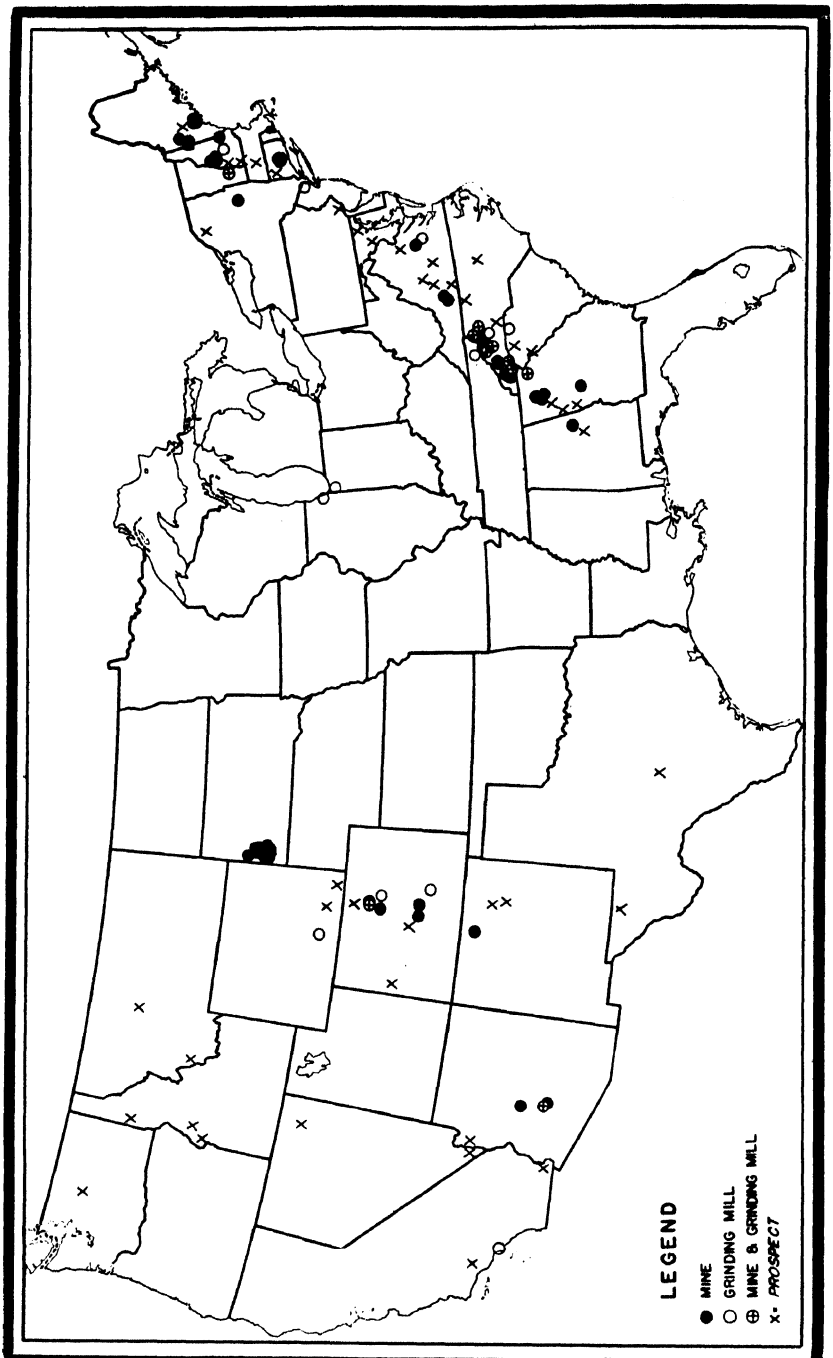

FIGURE 1.—Mica mines, prospects, and grinding mills in the United States.

In North Carolina more than 16,500,000 pounds of sheet and punch mica have been produced since 1868 in the 250-square-mile area around Spruce Pine, N. C. T. L. Kesler and J. C. Olson of the Geological Survey report that mica or feldspar has been mined in this area from more than 500 pegmatite bodies. These bodies, some of them more than 100 feet thick, are most closely associated with alaskite (a variety of granite) and occur both in the alaskite and in adjacent metamorphic rocks. Commercial mica is commonly localized in irregular shoots or "streaks" and even in these shoots is distributed so irregularly as to preclude adequate prospecting or development in advance of mining. From field studies and analysis of production records for 131 mines, these geologists concluded that systematic planning of mica mining in this area as a whole could easily raise the output of relatively clear sheet mica to 90,000 pounds a year, perhaps several times this amount. Careful measurements were made by E. L. Hall of the National Bureau of Standards of 196 samples collected from 109 mica mines and 15 feldspar mines, and samples from 71 mines were found to have power factors low enough to meet the rigid requirements of radio-transmitter and high-tension magneto-condenser manufacturers.

Scrap mica.—After a slight set-back in 1940, the production of "scrap mica" from domestic sources jumped to 32,500 short tons valued at $442,789, reflecting a sharp upturn in the rising demand curve and a reduction of imports from overseas. In addition to mine scrap, these figures include mica, recovered from washing kaolin or kyanite or by milling schist, amounting to 15,583 tons valued at $185,486, compared with 9,674 tons valued at $138,148 in 1940 and 10,011 tons valued at $108,899 in 1939.

Ground mica.—The production of ground mica likewise resumed its upward trend, advancing to 43,419 tons valued at $1,532,351 compared with the previous record of 30,924 tons worth $1,156,333 in 1939. Of special interest is the increase in output of wet-ground mica, which remained almost stationary around 3,000 tons a year until 1937, when it began to rise irregularly but rapidly. Following its rapid rise during the early 1930's, when other industries were in the doldrums, the output of dry-ground mica was seemingly stabilized after 1936, but in 1941 it also jumped into new high ground. Demand was active in all consuming outlets, and, although demands of the roofing industry accounted for the bulk of the increase, consumption in paint and miscellaneous uses showed the largest percentage gains.

The history of the scrap- and ground-mica industries over a series of years is indicated in figure 2.

Ground mica sold by producers in the United States, 1937–41, by methods of grinding

Year	Dry-ground [1]		Wet-ground		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	21,150	$457,879	6,095	$381,933	27,245	$839,812
1938	19,757	466,959	7,329	457,595	27,086	924,554
1939	23,222	547,539	7,702	608,794	30,924	1,156,333
1940	21,809	515,930	6,175	500,698	27,984	1,016,628
1941	31,914	733,559	[1] 11,505	[1] 798,792	43,419	1,532,351

[1] Includes mica from kaolin and schists; some from sericite schist included in wet-ground in 1941.

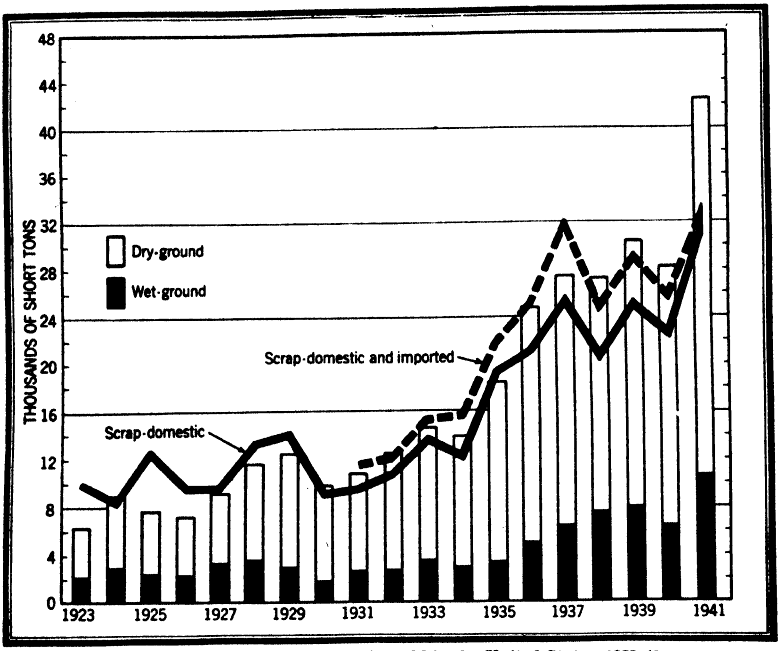

FIGURE 2.—Scrap and ground mica sold in the United States, 1923–41.

Ground mica sold by producers in the United States to various industries, 1940–41

Industry	1940			1941		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing [1]	18,359	66	$385,720	25,178	58	$498,946
Wallpaper	2,915	10	220,995	3,219	8	256,067
Rubber	1,731	6	144,202	3,476	8	223,182
Paint	1,874	7	141,192	4,020	9	253,294
Miscellaneous [2]	3,105	11	124,519	7,526	17	300,862
	27,984	100	1,016,628	43,419	100	1,532,351

[1] Includes mica from kaolin and schist.
[2] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, plastic specialties, textiles, and other purposes.

The question as to whether ground sericite can be commercially designated as "ground muscovite" or even as "ground mica" is controversial. Ordinary muscovite, damourite or hydromica, and oncosine or pinite all have roughly the same composition. Sericite and metasericite may be classified as subvarieties of damourite, which in turn is a variety of muscovite distinguished by small scales, which are less elastic, unctuous, and pearly to silky in luster. The term "sericite" is derived from the Greek word for "silky." It has been contended that the original sericite from the silky schist of the Nerothal near Wiesbaden was derived from the alteration of feldspar; some geologists insist that sericite is a secondary mineral and thus distinguishable from ordinary muscovite, which is primary.

Sericite is ground much more easily than ordinary muscovite or other forms of mica. Roughly prepared, it has been used extensively for roofing, as a refractory, in foundry facings, and as decorative

material (for example, Christmas-tree snow). In 1941, sericite from a gold mine at Kershaw, S. C., was actively marketed. This new product, which requires only light disintegration and washing to yield a 325-mesh product, is used mainly for casein paint. Although selling for less than half the price, it is claimed to be better than ordinary water-ground mica in varnishes and certain other protective coatings because it lacks sheen yet retains the fish-scale form, which is one of the superior properties of wet-ground compared with dry-ground muscovite.

Mixing ground mica (325-mesh) with aluminum bronze powder to save aluminum has produced a paint having superior resistance to salt air and chemical fumes. Micronized mica, which is produced under exclusive franchise by one North Carolina company, yields a product marketed as 100 percent passing the equivalent of 3,000-mesh and used as an extender or filler in paints and plastics. Biotite, similarly ground, is employed in lubricating greases, leather finishes, and other special applications. Alone or combined with graphite, increasing quantities of ground mica are used in foundry facings, parting base, and core or mold washes.

TOTAL CONSUMPTION OF BLOCK AND SHEET MICA

Economists unfamiliar with the mica business are amazed to find that it is impossible to establish a satisfactory statistical picture of the industry. By eliminating scrap and considering the production and trade in ground mica as a distinct industry, the problem is clarified; a further simplification is to segregate splittings and built-up mica, but even when the discussion is narrowed to uncut sheet or block mica, it is still impossible to give a satisfactory answer to the seemingly simple question as to how much is consumed in the United States.

During 1941, the consumption of virtually every class of mica increased greatly, but the principal increases were of the better qualities used for military radio and magneto condensers, airplane spark plugs, and other strategic uses. Monthly statistics of actual consumption and stocks of specified grades and qualities of block mica were first collected by the Bureau of Mines in July 1940, and these figures are summarized upon a quarterly basis in the form of bar charts in figure 3.

The statistics on domestic production of raw sheet or block and imports for consumption of all kinds of mica (manufactured as well as unmanufactured) other than scrap and ground mica are shown in the form of 5-year averages in an accompanying table. The sum of these figures tends to show that the average annual consumption of sheet mica, including imported manufactures, declined about 10 percent from 1925–29 to 1935–39. Actually, however, the total consumption was greater during the latter period, or at least the potential services rendered by the 6,038,958 pounds available annually during 1935–39 were greater than those afforded by the 6,672,519 pounds average total for 1925–29. This anomaly is due not only to the losses in manufacturing where parts of the sheet are trimmed away (in the same fashion that a suit of clothes weighs less than the material cut from the original bolt of cloth), but also to the difference in preparation of the so-called "uncut" sheets.

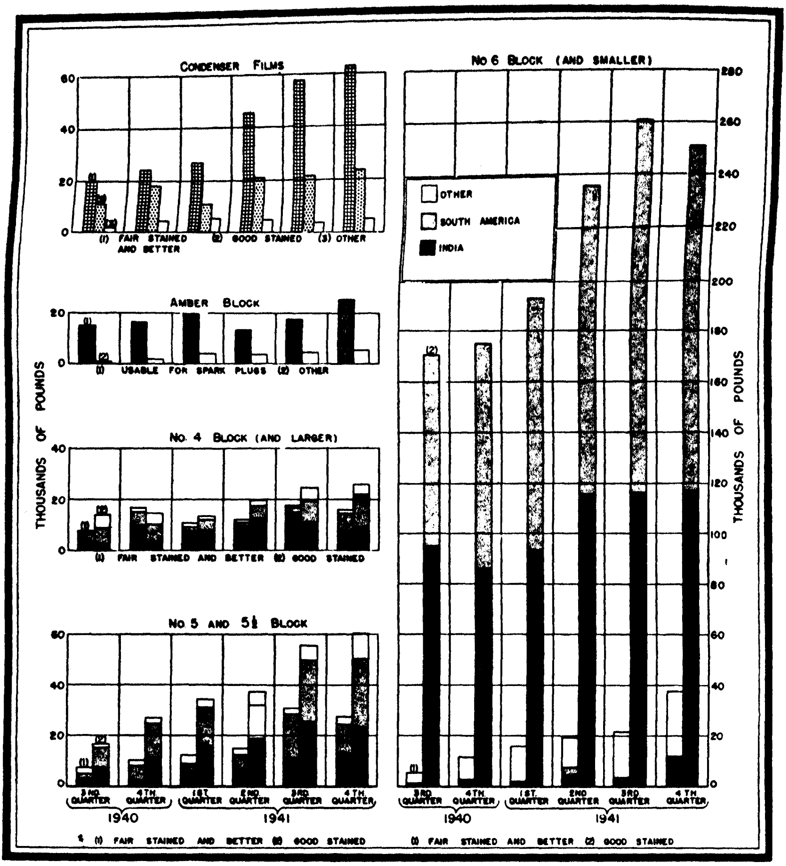

FIGURE 3.—Consumption of specified kinds of block mica in the United States, by quarters, July 1940 to December 1941.

Apparent consumption and changes in sources of supply of sheet mica (excluding scrap and ground mica), annual averages, 1925–29 and 1935–39

	Average quantity, in pounds		Average percent of total apparent supply	
	1925–29	1935–39	1925–29	1935–39
Domestic production (sales):				
Uncut punch	1,433,684	888,313	21.5	14.7
Uncut sheet larger than punch	405,400	252,411	6.1	4.2
Total production	1,839,084	1,140,724	27.6	18.9
Imports for consumption:				
Uncut block valued not above 15 cents	138,495	264,794	2.1	4.4
Uncut block valued above 15 cents	666,374	485,879	10.0	8.0
	804,869	750,673	12.1	12.4
Cut or trimmed to size (sheet)	63,960	81,209	.9	1.3
Other manufactured sheet	31,928	4,261	.5	.1
Splittings	3,921,373	4,020,860	58.7	66.6
Built-up mica	11,305	41,231	.2	.7
Total imports	4,833,435	4,898,234	72.4	81.1
Grand total	**6,672,519**	**6,038,958**	**100.0**	**100.0**

Mica comes from the ground in irregular pieces, which are roughly sorted or "cobbed" to remove the bulk of the scrap or waste mica suitable only for grinding. The remaining crystals or blocks are split roughly ("rifted") into thicknesses that permit careful inspection and easy cutting (usually less than ⅛ inch). The next step is "trimming" or cutting away imperfections. In Bengal all edge imperfections are removed by sickle, which leaves an irregular and often indented outline. Madras mica is trimmed by knife or guillotine shears; the outline is much more regular, the edges being all straight, corners sharp, and re-entrant angles absent. Smaller sizes of Madras sheet may be knife-cut into "rounds," but all Madras is closely trimmed. According to Wierum:[1]

After trimming, the sheets are graded or sized, generally by the use of a template upon which each piece is laid. The horizontal and vertical lines of the chart that are at the greatest distance from a given corner, and that are entirely covered by the piece of mica indicate its "grade" number or size. The sized sheets then go to sorters, who determine the quality of each piece. They are the most responsible and the best-paid workers at an Indian mica plant. Frequently these men are able greatly to improve the quality by removing stained films from the interior of a sheet, thus making two or more thinner pieces, but of perhaps double the value per pound with a loss of only a small fraction of the original weight.

Practically all countries except the United States and Canada follow approximately India's methods of trimming sheet mica, but few of them use the meticulous care of the native Indians or offer a product so entirely free from surface and edge imperfections. There is one peculiarity of the Bengal trim, however, that is not generally imitated in other producing countries, largely because it is unnecessary unless splittings are to be made from the sheets. It is the beveling of the edges, produced by holding the native sickle at a sharp angle when trimming the sheet.

The wastage in ordinary thumb-trimmed domestic mica has been estimated at fully 35 percent more than in Indian knife-trimmed. The waste in respect to domestic punch is much greater. One large consumer reports using about 350 pounds of North Carolina punch mica to make 100 pounds of washers and disks and approximately 155 pounds of domestic punch for 100 pounds of other die-cut products. A rough average for knife-trimmed mica is 150 pounds of raw mica for 100 pounds of stampings. In respect to condenser films, due to additional losses in splitting it takes less than 200 pounds of imported and 300 to 400 pounds of domestic condenser splits to make 100 pounds of finished rectangular films. South American mica in general is trimmed less closely than Indian but more closely than domestic.

In Minerals Yearbook, 1940, an attempt was made to show the domestic consumption of sheet mica in 1937 by uses. Of an estimated total of 2,600,000 pounds used in the United States in that year, 43 percent was used for washers, disks, and other small stampings; 29 percent for radio-tube parts; 19 percent for electrical appliances; 6 percent for condensers; 2 percent for aviation spark plugs; and less than 1 percent for miscellaneous uses. An estimate for July 1941 shows only 26 percent for washers, etc.; 35 percent for radio-tube parts; 10 percent for electrical appliances; 23 percent for condensers; 5 percent for spark plugs; and 1 percent for miscellaneous uses.

The foregoing figures include allowances for block-mica equivalents of imported condenser splits and involve other broad assumptions but tend to confirm the increasing importance of radio condensers

[1] Wierum, H. F., The Mica Industry: U. S. Tariff Commission Report 130, 2d ser., 1938, pp. 51-52.

and tubes for military communications and aviation spark plugs relative to consumers' durable goods and even industrial equipment. A further effect of this wartime change in the pattern of demand is the relative increase in requirements for the better grades of mica, notably condenser mica. Approximately half of the consumption of condenser mica in 1941 was of fair-stained or better qualities, chiefly sizes 5 and 5½, for transmitter or high-tension condensers.

Figure 4 summarizes graphically the situation with respect to imports and domestic production. The tremendous and growing importance of imported mica splittings is clearly shown in this chart. As regards block mica, because no adjustment is made for the large

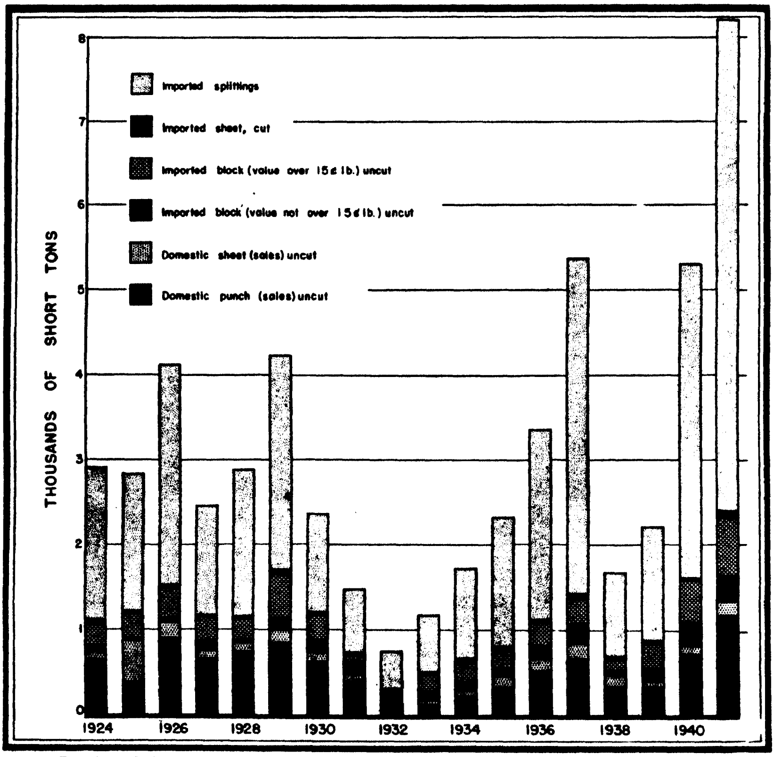

FIGURE 4.—Block and sheet mica (cut) and splittings imported for consumption in the United States, and sales of domestic sheet and punch mica, 1924-41.

wastage due to the rough trimming of domestic mica, the relative importance of domestic production is much less even than the chart indicates. The comparison probably would more nearly approximate actual manufacturing conditions if the quantities of domestic punch were reduced at least one-half and possibly two-thirds.

MICA SPLITTINGS

Notwithstanding a large increase in consumption over the 1940 all-time record, industry stocks of mica splittings increased during 1941, and a sizable Government-owned stock pile was created. Consumption of amber splittings increased even more rapidly than that of

muscovite splittings during the latter half of 1940; but before the end of the first quarter of 1941 stocks were depleted, and prospects of obtaining supplies from Madagascar worsened so that consumption of such splittings began to decline sharply. Consumption of muscovite splittings reached a peak in May 1941 but rose to even higher levels in October, after which various voluntary conservation measures and the prospective curtailment in manufacture of civilian goods reduced the demand for built-up mica and consequently the consumption of splittings of all categories. No. 6 loose splittings represented 85 percent of the total consumption of muscovite splittings during the fourth quarter of 1940 and 80 percent of the total during the corresponding period of 1941. Even in this group, the proportion of first and second qualities increased sharply, whereas that of third quality diminished, but the trend to use higher grades was more marked in respect to larger splittings, especially those that were book-packed.

Production of splittings in the Western Hemisphere has been confined largely to Canada. Phlogopite tends to split somewhat more readily than muscovite, and, in addition to the hand-made splittings produced in Quebec, variable but in some years substantial quantities of Canadian phlogopite have been imported (under lower-duty brackets) and split mechanically. Serious consideration has been given to increasing this business, and additional equipment was installed in 1941 for this purpose. As Canadian experience indicated a definite correlation between aptitude for splitting mica and ability to execute fine needlework, consideration also has been given to establishing a mica-splitting industry based upon Brazilian block mica in Puerto Rico; but this plan has not materialized, and steps have been taken to expand the small production of splittings in Brazil. Still another proposal is to bring small Brazilian block mica to Mexico for splitting. Late in 1941, the mining of amber mica near Oaxaca, Mexico, attained some importance, and several hundred Mexicans were trained in the art of making splittings. They have shown more aptitude for this work than Brazilians or Anglo-Saxon workers, and, as wages in the small towns or villages are 1 peso or less than $0.25 a day, it would seem possible to expand the Mexican splitting industry to include Brazilian or even domestic muscovite.

Consumption and stocks of mica splittings in the United States, 1937–41, by sources, as reported by the consumers

Year	India		Canada		Madagascar		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption [1]								
1937	3,721,594	$965,418	98,618	$51,960	527,223	$240,267	4,347,435	$1,257,645
1938	1,446,349	511,674	41,100	20,401	180,357	80,390	1,667,806	612,465
1939	2,995,626	905,763	107,101	44,065	320,317	139,855	3,423,044	1,089,683
1940	4,252,120	1,358,534	54,044	28,491	612,697	338,497	4,918,861	1,725,522
1941	6,473,459	2,334,432	179,783	131,350	644,386	367,157	7,297,628	2,832,939
Stocks in consumers' hands Dec. 31.								
1937	3,920,730	1,094,414	77,130	33,722	444,762	195,976	4,442,622	1,324,112
1938	4,057,681	1,128,075	55,827	24,378	631,119	273,926	4,744,627	1,426,379
1939	2,754,748	857,656	52,523	17,697	673,354	273,465	3,480,625	1,148,818
1940	4,620,934	1,776,974	53,378	35,581	738,489	410,068	5,412,801	2,222,623
1941	9,212,891	3,434,336	115,529	81,988	223,235	134,143	9,551,655	3,650,467

[1] Exclusive of a nominal quantity of splittings produced in the United States and South America.

Beginning with July 1940 the Bureau of Mines began to collect monthly statistics of consumption and stocks of mica splittings by sizes and qualities for the information of all the defense agencies. The consumption figures are summarized graphically upon a quarterly basis in figure 5.

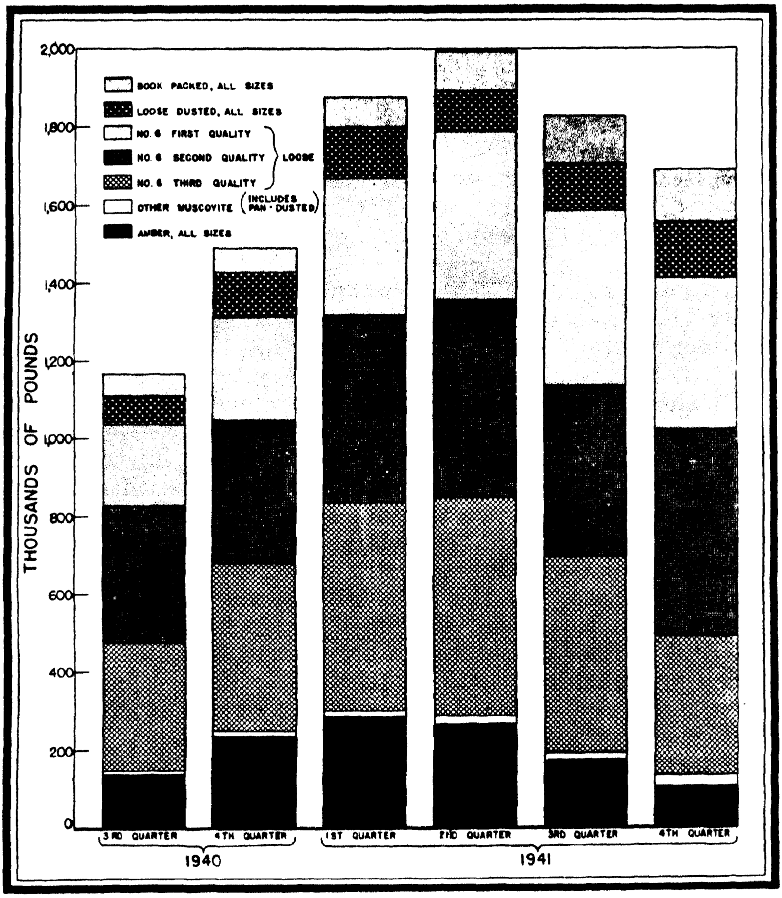

FIGURE 5.—Consumption of specified sizes and qualities of mica splittings in the United States, by quarters, July 1940 to December 1941.

BUILT-UP MICA

As indicated by the quarterly consumption figures for mica splittings shown in figure 5, factories handling built-up mica were operating virtually at capacity during the early part of 1941, but, as the growing shortages of metals and other materials brought about curtailment in the manufacture of electrical appliances and other consumers' durable goods and as some wartime substitution and conservation of mica began to take effect, demand for built-up mica diminished during the latter half of the year. Nevertheless, the total poundage for the year was 50 percent higher than the previous all-time record of 1940, and the value of the output was almost 40 percent higher.

Built-up mica produced in the United States, 1940–41, by kind of product [1]

Product	1940		1941	
	Pounds	Value	Pounds	Value
Molding plate	1,315,000	$1,410,000	1,873,822	$1,854,000
Segment plate	1,510,000	2,024,000	2,317,364	2,599,000
Heater plate	561,000	878,000	539,410	789,000
Flexible (cold)	330,000	383,000	705,532	754,000
All other (tape, etc.)	697,000	1,116,000	1,199,361	2,089,000
	4,413,000	5,811,000	6,635,489	8,085,000

[1] Partly estimated.

PRICES

It is generally conceded that, during the 1930's and for some time before, the broad trend of mica prices was upward, with prices of smaller and poorer kinds increasing relatively faster than those of the larger and better grades and sizes. Military requirements, however, have taxed the ability of the world's miners to supply mica of qualities equal to India good-stained or better. Late in 1941, progressive curtailment in production of refrigerators and other electrical appliances for civilian use diminished the demand for ordinary electrical and stove mica, and even before that the demand for these lower grades did not keep pace with that for higher qualities. Consumer acceptance of Brazilian mica and to some extent of domestic mica also has tended to place mica from other countries more nearly on the same price levels as comparable Indian grades. The net result of these market forces has been to advance prices of all kinds of mica together in response to the much higher cost of ocean transportation and insurance on shipments from India.

During 1940, efforts to stimulate domestic production resulted in relatively higher prices for punch and circle mica on the theory that this was the bulk-line product and so would afford maximum encouragement to the miners, but in 1941 the prices of North Carolina punch remained almost stationary while those of sheet or pattern mica increased. Toward the end of the year, owing to the falling off in demand for washers and other die-cut or shear-cut mica for household-appliance manufacturers who were unable to get priorities on metallic parts, prices of all kinds of domestic electrical mica began to weaken, suggesting a definite reversal of the pre-war trends favoring No. 6 Indian good-stained and lower grades.

Quantitative comparisons of mica prices, especially over a period of years, are impaired by the flexibility of standards and the fact that prices quoted by different suppliers, even on the same day, may vary widely. In December 1941, for example, one importer quoted two classes of No. 6 first-quality loose muscovite splittings at 36 and 46 cents a pound, respectively, and during the latter half of 1941 an important consumer paid as little as 34 and as much as 47 cents for splittings of this same designation. Weighted averages of all purchases by this consumer advanced from 31.1 cents during the pre-war period July 1 to September 30, 1939, to 39.8 cents during the period July 1, 1941, to January 31, 1942—an increase of 28 percent. Another large consumer reported an apparent increase averaging

more than 30 percent (on a lower price range), whereas one leading importer reported an average advance of 35 percent and another 14 percent on this same large volume item. In respect to No. 6 seconds, an even larger tonnage item, reports from various users indicate a pre-war range of 18½ to 26 cents and 1941 year-end figures of 23 to 30 cents, indicating an average increase of at least 25 percent. Prices of Indian block mica are even more difficult to evaluate, as the spread between f. o. b. prices of different shippers tends to be greater even than that for splittings. Based upon the meager evidence available, it would appear that wartime increases in prices of standard good-stained Indian mica at the end of 1941 ranged from 10 to 25 percent, whereas those of Brazilian mica increased 25 to 50 percent or even more as a result of the narrowing of discounts on such mica as compared with similar Indian grades and sizes. In respect to the better grades of condenser splits, the increases were at least 50 percent and often more.

Before the war, the rupee depreciated in value from 37½ cents in 1936 to 30 cents in September 1939, but this was more than offset by higher prices in the bazaars, so that even in United States currency the mica price trend during that period was upward. After the outbreak of hostilities and throughout 1940 and 1941, rupee exchange remained steady while freight and insurance advanced. Based upon the net mica content of all shipments, ocean freight was equivalent to about 6 mills a pound until September 1939 but rose to 17 mills at the end of 1941. War risk and marine insurance, which before the war was 0.25 percent from Calcutta to New York, after Pearl Harbor jumped to 8 percent by way of Cape of Good Hope and 10 percent across the Pacific. Even as late as the early summer of 1941, the insurance rates on shipments in United States vessels were only 1.5 percent via the Cape and 0.5 percent via Panama or Transpacific. On shipments from Brazil, war-risk insurance was 0.10 percent before Pearl Harbor, after which it jumped to 1.5 percent.

FOREIGN TRADE [2]

Imports.—In 1941 the total imports of all kinds of mica increased to 8,300 short tons valued at $4,415,031 compared with 7,688 tons valued at $2,484,128 in 1940. Waste and scrap phlogopite imports nearly doubled, but imports of other waste and scrap declined to a mere fraction of their 1940 volume. Imports of untrimmed phlogopite declined moderately, while those of the higher grades of sheet mica increased substantially. Further details on imports by kinds and sources of origin are indicated in the following tables.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Mica imported for consumption in the United States in 1941, by kinds and by countries

Country	Unmanufactured									
	Waste and scrap, valued not more than 5 cents per pound				Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 inch by 2 inches may be cut (duty, 10 percent)		Other			
	Phlogopite (duty, 15 percent)		Other (duty, 25 percent)				Valued not above 15 cents per pound n. e s (duty, 4 cents per pound)		Valued above 15 cents per pound (duty, 4 cents per pound+25 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:										
Madagascar							220	$19	21,732	$15,302
Portuguese Africa									3,182	1,423
Union of South Africa							156	18	563	197
Argentina							125,571	17,140	93,895	53,351
Bolivia							449	42	163	65
Brazil							294,373	36,649	706,098	409,231
Canada	2,434,080	$12,452	48,600	$266	164,870	$21,904	37,792	4,793	94,227	65,705
Guatemala									1,272	357
India, British			4,200	52			12,127	1,456	435,423	477,627
Japan									2,912	959
Mexico			14,583	21			108	14	8,135	2,385
Peru							2,953	232	2,833	1,461
United Kingdom									7,798	9,254
Total: 1941	2,434,080	12,452	67,383	339	164,870	21,904	473,749	60,363	1,378,233	1,037,317
1940	1,224,796	5,649	4,897,935	16,962	189,960	20,171	381,623	46,740	962,605	509,654

Country	Manufactured—Films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty, 45 percent)		Total films and splittings	
	Not above 12 ten-thousandths of an inch in thickness (duty, 25 percent)		Over 12 ten-thousandths of an inch in thickness (duty, 40 percent)					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa: Madagascar	107,420	$21,979					107,420	$21,979
Argentina	59	34	244	$124			303	158
Brazil	538	432	13,002	5,555			13,540	5,987
Canada	294,281	159,856	110	178	100	$350	294,491	160,384
France	794	202					794	202
India, British	10,694,560	2,486,631	499,587	416,684	14,710	38,922	11,208,857	2,942,237
Japan			20,980	8,549			20,980	8,549
United Kingdom	42,936	12,429	146	1,051			43,082	13,480
Total: 1941	11,140,588	2,681,563	534,069	432,141	14,810	39,272	11,689,467	3,152,976
1940	7,016,666	1,568,482	350,055	203,629	19,676	23,812	7,386,397	1,795,924

Mica imported for consumption in the United States in 1941, by kinds and by countries—Continued

Country	Manufactured—Cut or stamped to dimensions, shape, or form (duty, 40 percent)		Manufactured—Other: Mica plates and built-up mica (duty, 40 percent)		Manufactured—Other: All manufactures of which mica is the component material of chief value (duty, 40 percent)		Manufactured—Other: Ground or pulverized (duty, 15 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	7,359	$4,542						
Canada	350	550					197,750	$2,625
Guatemala	2,192	1,030						
India, British	148,624	97,844	1,786	$997	4,850	$7,025		
Peru	2,026	1,174						
United Kingdom	1,200	1,024	26,088	12,869				
Total: 1941	161,751	106,164	27,874	13,866	4,850	7,025	197,750	2,625
1940	76,010	69,641	16,605	15,001	540	540	239,280	3,846

Exports.—Exports of mica, both unmanufactured and manufactured, were higher in 1941 than in 1940. The great increase in exports to Africa and to Latin America is noteworthy.

Mica and manufactures of mica exported from the United States in 1941, by countries

Country	Unmanufactured		Manufactured: Ground or pulverized		Manufactured: Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	428,775	$4,967	690,238	$25,311	97,436	$165,295
Cuba			12,000	455	1,276	3,044
Mexico	2,000	94	18,550	1,183	3,152	4,594
Other North America			2,773	187	1,955	2,414
South America:						
Argentina			53,405	2,153	1,255	2,779
Brazil			49,750	1,665	9,551	6,741
Chile					5,851	11,194
Venezuela			258,000	6,570	261	296
Other South America			4,400	168	4,548	3,740
Europe:						
Spain			2,000	80	333	495
United Kingdom			336,000	9,580	30	600
Other Europe					717	946
Asia:						
China					506	855
India, British			49,000	1,173	1,093	2,624
Netherlands Indies			47,700	1,869	1,732	5,734
Other Asia					1,537	3,903
Africa	2,000	80	208,460	4,681	979	1,955
Oceania			26,900	1,132	2,720	2,253
Total: 1941	432,775	5,141	1,759,176	56,207	134,932	219,462
1940	315,565	2,524	1,412,309	52,284	78,467	136,742

WORLD PRODUCTION

Owing to disturbed conditions throughout the world, data on production in foreign countries are scanty. The following table presents available figures.

World production of mica, 1937–41, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
North America:					
Canada (sales)	857	470	790	(2)	(2)
Mexico (exports)	(2)	(2)	(2)	39	36
United States (sold or used by producers) [3]	23,626	18,803	22,751	21,046	30,693
South America:					
Argentina [4]	225	250	298	442	[5] 550
Bolivia (exports)	9	4	----------	1	(2)
Brazil (exports)	330	521	435	1,117	867
Peru	5	24	9	4	8
Europe:					
Italy	24	122	(2)	(2)	(2)
Norway (exports)	42	104	25	(2)	(2)
Rumania	27	22	18	(2)	(2)
Sweden	68	131	126	(2)	(2)
Asia:					
Ceylon (exports)	1	(6)	(6)	2	(2)
Chosen	[5] 70	(2)	(2)	(2)	(2)
India, British (exports)	15,106	8,896	10,104	(2)	(2)
Africa:					
Madagascar	583	677	(2)	531	(2)
Nigeria	----------	3	(2)	(2)	(2)
Portuguese East Africa	----------	----------	17	(2)	(2)
Rhodesia					
Northern	4	4	2	(2)	(2)
Southern	17	13	6	(2)	(2)
Tanganyika Territory	71	37	36	10	(2)
Union of South Africa: Transvaal	1,740	1,116	972	1,252	[7] 538
Oceania					
Australia.					
Northern Territory	42	49	34	32	(2)
South Australia	43	17	56	70	(2)
Western Australia	----------	----------	(6)	1	(2)
New Zealand	(2)	(2)	(2)	(6)	(2)

[1] In addition to the countries listed, mica is also produced in Australia (Queensland and New South Wales), Eritrea, Kenya, and U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Includes following quantities recovered from kaolin and schists 1937, 9,558 tons; 1938, 5,942 tons, 1939. 9,082 tons; 1940, 8,776 tons, 1941, 14,137 tons.
[4] Rail and river shipments.
[5] Official estimate
[6] Less than 1 ton.
[7] January to June, inclusive.

SALT

By F. E. Harris and K. G. Warner

SUMMARY OUTLINE

SUMMARY

Total salt production in 1941, which aggregated 12,720,629 short tons valued at $33,620,376, increased 23 percent in quantity and 27 percent in value compared with 10,359,960 tons valued at $26,474,619 (revised figures) in 1940. Of the total in 1941, salt in brine increased 27 percent, evaporated salt 20 percent, and rock salt 16 percent. The unit value per ton of the total salt increased from $2.56 (revised figure) to $2.64.

Increased supplies of various kinds for waging war required larger quantities of salt of all classes—a fact confirmed not only by the following table of salient statistics but by figures obtained regarding uses of salt. Although the import statistics for 1941 given below cover only 9 months of the year, they indicate a declining rate. Exports likewise declined; however, they maintained the favorable trade balance that has existed for some years past.

Salient statistics of the salt industry in the United States, 1930–34 (average), 1935–39 (average), and 1940–41

	1930-34 (average)	1935-39 (average)	1940	1941
Sold or used by producers:				
Manufactured (evaporated) short tons	2,251,226	2,507,374	2,782,741	3,330,106
In brine do	3,333,391	4,205,587	[1] 5,311,671	6,771,436
Rock salt do	1,822,889	1,947,254	2,265,548	2,619,087
Total:				
Short tons	7,407,506	8,660,215	[1] 10,359,960	12,720,629
Value [2]	$22,331,641	$23,405,612	[1] $26,474,619	$33,620,376
Average per ton [2]	$3.01	$2.70	[1] $2.56	$2.64
Imports for consumption:				
For curing fish short tons	20,360	[3] 21,250	[3] 12,965	[4] 4,820
Value	$34,492	[3] $43,722	[3] $25,174	[4] $16,421
In bags, barrels, etc. short tons	2,620	1,385	1,024	[4] 915
Value	$24,796	$11,813	$6,601	[4] $9,300
In bulk short tons	16,721	24,131	16,413	[4] 5,870
Value	$37,579	$55,876	$59,029	[4] $13,331
Total:				
Short tons	39,701	46,766	30,402	[4] 11,605
Value	$96,867	$111,411	$90,804	[4] $39,052
Exports:				
Short tons	88,662	90,214	147,044	[4] 87,807
Value	$642,384	$521,652	$699,340	[4] $575,988
Apparent consumption short tons	7,358,545	8,616,767	[1] 10,243,318	([5])

[1] Revised figures.
[2] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.
[3] Includes salt in bags, sacks, barrels, or other packages: 1938, 93 tons valued at $673; 1940, 6 tons, $12.
[4] Figures cover January to September, inclusive.
[5] Figures not available for publication.

The accompanying graph (fig. 1) illustrates how strikingly the great demand on the chemical industries affected the curve that represents the quantity of salt in brine produced and used in 1941. The index for salt in this category paralleled very closely the index of industrial activity throughout the period graphed (1935–41) and during 1941 accompanied the rising index of general business, passing it by 5 points. The curve of the combined quantity of evaporated and rock salt produced or sold was not quite so spectacular in its progress. In 1935 this salt of commerce began at a higher level and rose until 1937, but thereafter, in common with salt in brine and general business, it dropped and reached a low point in 1938. However, this drop was in the nature of a sag rather than a sharp decline, for it was still 8

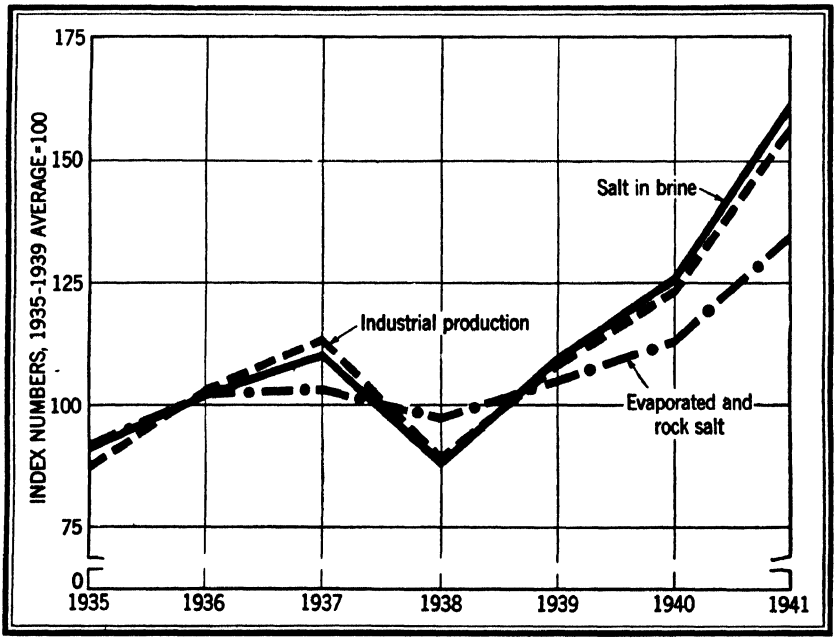

FIGURE 1.—Index of salt used in brine and of evaporated and rock salt compared with Federal Reserve Board index of industrial activity, 1935–41.

points above general business and 9 above salt in brine. From 1938 on it rose steadily, and although in 1941 it failed to attain the height of general business by 22 points its tonnage was the highest in history.

In numerous sections of the country wages increased as much as 13 to 45 percent. In some localities labor was scarce or not available. Fuel costs in one area increased as much as 60 percent. Bags and other packaging material cost considerably more. Where producers had difficulty in obtaining the required materials with which to work and could not make necessary repairs on their plants their output declined. Those who experienced a combination of all these difficulties plus competition—which precluded higher prices—said the profits in 1941 were negligible.

In Puerto Rico the imposed tax of 1 cent per pound of salt sold prevailed until August 12, 1941, when it was repealed.

PRODUCTION

The output of salt from mines, wells, and ponds in the United States was reported to the Bureau of Mines by 83 plants of 65 companies in 13 States and Puerto Rico for 1941 compared with 83 plants of 66 companies that reported for 1940.

Production by States.—In 1941, as in years past, Michigan ranked first in total production of salt, as well as of evaporated salt, and New York led in rock-salt production.

Salt sold or used by producers in the United States, 1939–41, by States

State	1939		1940		1941	
	Short tons	Value	Short tons	Value	Short tons	Value
California	404,689	$1,980,777	469,354	$2,200,640	484,632	$2,290,265
Kansas	641,752	2,591,934	684,053	2,710,847	781.014	3,254,828
Louisiana	1,072,540	2,830,331	1,132,594	2,804,406	1,242,242	3,251,492
Michigan	2,408,872	6,726,912	[1] 2,863,035	[1] 7,479,905	3,620,649	10,975,872
New Mexico	(2)	(2)	13,915	41,573	16,641	51,514
New York	2,041,492	5,855,422	2,117,671	6,523,775	2,719,586	7,416,734
Ohio	1,794,788	2,647,355	2.080,133	2,781,599	2,510,096	3,367,544
Oklahoma	(2)	(2)	(2)	(2)	10,743	42,737
Puerto Rico	13,325	57,707	11,724	62,645	14,444	72,220
Texas	352,008	604,633	402,165	792,214	656,569	1,713,508
Utah	68,100	202,244	71,472	191,263	107,079	196,413
West Virginia	144,727	773,988	144,312	701,953	143,780	792,104
Other States [3]	335,618	238,377	369,532	183,799	413,154	195,145
	9,277,911	24,509,680	[1] 10,359,960	[1] 26,474,619	12,720,629	33,620,376

[1] Revised figures.
[2] Included under "Other States."
[3] 1939: Colorado, New Mexico, Oklahoma, and Virginia; 1940. Colorado, Oklahoma, and Virginia; 1941: Colorado and Virginia.

Methods of manufacture.—Evaporated salt is manufactured either from natural brine of wells and ponds or by forcing water into salt beds and withdrawing it. The brine is evaporated by one of several methods. Salt evaporated in open pans or grainers is flaky and differs physically from the resulting grains of other methods. It is commonly known as flake salt and in the industry as grainer salt, and it is classified on standard lists as "medium" salt, being popular for certain food uses. Salt quoted on the market as vacuum fine is evaporated in vacuum "pans," which are mainly upright cylinders in single or multiple "effects." The product is a fine salt classified as evaporated granulated. Most of it is used for table salt. Solar salt is the product of sea water or inland playas. After the salt water goes through a series of settling ponds the salt is harvested. It may then be treated further in vacuum pans to produce fine table salt, or it may be screened and sized. The coarse salt is employed for industrial purposes for which rock salt may be used. Rock salt is mined or quarried and is crushed and sized for industrial uses. In some deposits it is pure enough for table salt after crushing and screening.

Salt sold or used by producers in the United States, 1940–41, by methods of manufacture

Method of manufacture	1940		1941	
	Short tons	Value	Short tons	Value
Evaporated:				
Bulk:				
Open pans or grainers	505,491	$4,247,212	501,236	$4,100,293
Vacuum pans	1,667,273	9,753,419	2,192,142	12,596,983
Solar	457,710	1,634,603	454,397	1,577,740
Pressed blocks	152,267	1,193,237	182,331	1,505,040
Rock:				
Bulk	2,225,377	7,102,404	2,562,386	8,300,562
Pressed blocks	40,171	282,435	56,701	461,265
Salt in brine (sold or used as such)	[1] 5,311,671	[1] 2,261,309	6,771,436	5,078,493
	[1] 10,359,960	[1] 26,474,619	12,720,629	33,620,376

[1] Revised figures.

Evaporated salt.—Sixty-one plants in 12 States and Puerto Rico supplied evaporated salt, as shown in the following table:

Evaporated salt sold or used by producers in the United States, 1940–41, by State

State	1940		1941	
	Short tons	Value	Short tons	Value
California	462,403	$2,172,666	455,038	$2,171,889
Kansas	231,896	1,732,079	279,115	2,119,917
Louisiana	57,868	320,127	38,138	294,558
Michigan [1]	964,491	5,232,409	1,129,714	6,027,100
New York	372,049	3,683,490	438,451	4,006,454
Ohio	419,054	2,436,929	481,364	2,817,183
Oklahoma	(2)	(2)	10,743	42,737
Puerto Rico	11,724	62,645	14,444	72,220
Texas	(2)	(2)	232,643	1,190,684
Utah	(2)	(2)	99,426	172,954
West Virginia [1]	144,312	701,953	143,780	792,104
Other States [3]	118,944	486,173	7,250	72,256
	2,782,741	16,828,471	3,330,106	19,780,056

[1] Includes a quantity of salt contained in brine for chemical use reported as evaporated salt with value as evaporated salt.
[2] Included under "Other States."
[3] 1940. Colorado, New Mexico, Oklahoma, Texas, and Utah; 1941: Colorado and New Mexico.

Rock salt.—The output of rock salt came from 22 plants in 8 States—chiefly New York, Louisiana, Kansas, Michigan, and Texas, in order of output; California, New Mexico, and Utah also produced some.

Rock salt sold by producers in the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	2,030,432	$6,447,648	1940	2,265,548	$7,384,839
1938	1,901,861	6,252,081	1941	2,619,087	8,761,827
1939	2,035,157	6,496,807			

Pressed blocks.—The output of pressed blocks from both evaporated and rock salt totaled 239,032 short tons valued at $1,966,305 in 1941 and increased over 1940. This does not include blocks that may have been made from salt bought on the open market but is confined to

sales by the original producers of the salt. As in 1940, 19 evaporated-salt plants and 8 rock-salt plants made the output of pressed blocks reported.

The Department of Agriculture says that the quantity of salt required by cattle varies according to forage and other conditions but that it is well to allow an average of 2 pounds a month per head for all cattle 1 year old and over. For calves, it was concluded that 0.5 to 1 percent of salt may be added to the grain mixture to supplement the ration and that it may also be kept in a box available to the calves at all times. The average for sheep is about 1 pound a month. For mules and draft horses, some of the tests showed that the average consumption a month was 3.4 pounds; heavy labor and warm weather influence the requirements so that under such conditions they consumed almost twice that average. Practical experience showed that unless the salt lost by sweating was replaced the animals soon exhibited signs of excessive fatigue.

Pressed-salt blocks sold by original producers of the salt in the United States, 1937–41

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	120,061	$966,812	28,981	$240,251	149,042	$1,207,063
1938	136,699	1,116,272	36,258	281,109	172,957	1,397,381
1939	152,121	1,136,527	39,242	263,300	191,363	1,399,827
1940	152,267	1,193,237	40,171	282,435	192,438	1,475,672
1941	182,331	1,505,040	56,701	461,265	239,032	1,966,305

Salt content of brine.—In 1941, as in the past few years, the salt of brine registered the greatest increase in output; most of it is utilized in the manufacture of chemicals. The Federal Reserve index shows that production of chemicals in 1941 averaged 137 (1935–39=100) compared with 115 in 1940, 102 in 1939, and 96 in 1938. Bureau of Mines statistics indicate that salt of brine was 53 percent of the total salt produced in 1941 and was supplied by 10 plants in various parts of the United States.

USES

As is well-known, there is no scarcity of this most commonly used chemical raw material—salt. Furthermore, producers of the raw material can increase their capacity at a greater rate than the consuming industries can expand their plants. In 1941 the increased requirements for salt were satisfied even though many new chemical plants and additions to existing plants were built during the year.

Salt sold or used by producers in the United States, 1940–41, by classes and uses, in short tons

Use	1940			1941		
	Evaporated	Rock	Brine	Evaporated	Rock	Brine
Chlorine, bleaches, chlorates, etc.	[1] 381,553	539,471	368,218	[2] 710,013	619,489	496,128
Ammonia-soda	500		4,909,840	1,500		6,226,821
Dyes and organic chemicals	[1] 222,425	24,123		[2] 91,052	37,798	
Soap (precipitant)	18,171	17,918		35,196	17,086	
Other chemicals	58,700	180,585	(3)	61,924	218,570	(3)
Textile processing	40,804	55,398		63,523	75,744	
Hides and leather	97,848	116,201		79,063	139,041	
Meat packing	368,664	334,528		422,017	409,241	
Fish curing	34,207	2,260		34,939	6,363	
Butter, cheese, and other dairy products	80,300	5,922		105,179	4,664	
Canning and preserving	98,527	16,144		128,143	16,356	
Other food processing	149,771	5,292		172,068	14,827	
Refrigeration	27,411	74,121		30,489	94,790	
Livestock	478,468	268,975		519,027	254,031	
Highways, railroads, dust and ice control	25,596	138,380		26,382	167,126	
Table and other household	428,587	65,775		420,532	75,289	
Water softening	123,624	65,739		165,610	187,445	(3)
Agriculture	26,552	25,808		50,523	21,261	
Metallurgy	13,609	43,065		25,690	41,288	
Other uses	107,424	285,843	33,613	187,236	218,678	48,487
	2,782,741	2,265,548	[4] 5,311,671	3,330,106	2,619,087	6,771,436

[1] Some salt used for chlorine included under "Dyes and organic chemicals."
[2] Some salt used for dyes and organic chemicals included under "Chlorine."
[3] Included under "Other uses."
[4] Revised figures.

As may be seen in the accompanying table of uses for 1940 and 1941, large quantities of both evaporated and rock salt, as well as salt in brine, were used in manufacture of chemicals. The quantities so used increased in 1941—more of the increase being in evaporated than in rock salt.

As glass has been relied upon increasingly to replace some of the metals heretofore used in such articles as refrigerator and stove parts, cooking utensils and other items, and containers to substitute for tin cans, demands on soda-ash plants have increased tremendously. By the fall of 1941, soda plants were producing at full capacity and were beginning to run behind in deliveries. For making glass a dense type of soda ash is used; hence, there is said to be slight competition or none with most of the other industries for supplies because the majority of the latter use a light type. However, there was an important increase in requirements of soda ash for many uses.

The other element in salt—chlorine—has been prominent in the news in many ways, as here, too, the war has made huge additional demands. Control of its use had to be tightened even more than in 1940, and Government defense agencies issued several pronouncements in this regard. In July 1941, full priority control of chlorine became effective. New units for making chlorine were completed in 1941, but the chlorine situation is still tense. Large quantities are employed in high-octane gasoline for tanks and planes. The manufacture of munitions (particularly smokeless powder and explosives), parachutes, and antifreeze agents also consumes chlorine. The use of chlorine in water purification has increased tremendously in view of the necessity for providing ample water supplies in new industrial areas, army camps, air fields, and naval bases. Chlorine enters into the processing of great quantities of textiles for such quartermaster supplies as

sheets, blankets, and tents. Some chlorine is used in plastic parts of airplanes.

Chlorine is incorporated in sprays to fumigate stored grain against weevils and various bacteria, including the fermenting bacteria, which increased last year because of weather and other conditions. Some methods of cleaning clothes require in the aggregate a great deal of chlorine. Many metallurgical processes require chlorine in some form. Production of magnesium metal has soared in the last year. In the process utilizing sea water from the Gulf of Mexico, hydrochloric acid (made from salt) converts the magnesium hydrate into magnesium chloride. Much of the chlorine, however, is recycled through the process, and only limited quantities are required to counteract process losses. Plants now under construction in the West will manufacture magnesium metal by another method that will utilize chlorine gas from salt.

Iron and steel smelting and refining consume by far the greatest part of the salt used in metallurgical plants; zinc processing and vanadium roasting utilize minor quantities.

Salt serves a very important purpose in the treatment and softening of water, because in many industries the quality of the water bears directly on both the processing and the quality of the finished products. In some industries water is used in such large quantities that it constitutes one of the raw processing materials. For example, great volumes of treated water are needed in paper making. In textile manufacture, as well as in paper making, impure water may affect bleaching and dyeing. Moreover, hard water may have an injurious effect on sizing. In water softening the salt is not used direct but to regenerate the zeolite which is the real softener. Chlorine is the most important chemical, derived from nonmetallic minerals, that is employed in water purification. It also prevents collection of slime and corrects corrosive waters.

For years salt has been used for ice control on city streets and on the subsurface soil of railroad beds to prevent the tracks from heaving, as it reduces freezing. It is also used to stabilize clay and gravel roads. The method has proved particularly successful for such roads in cold climates, where freezing is the chief cause of cracks. Wartime economy directs special attention to the fact that cracks in highways are exceedingly hard on rubber tires and probably will be still harder on a synthetic substitute; the suggestion has been made that cracking of clay and gravel roads be taken care of by salt treatment. Literature has been cited and quotations given in past issues of Minerals Yearbook and other Bureau of Mines reports, bearing on the use of salt for stabilizing roads.

Information with regard to the use of salt in drinking water to replace the chloride lost from the human body through sweating when working in hot places was included in a Bureau of Mines report in 1941.[1] In this connection a large steel company that has supplied its workers with salt tablets beside the drinking fountains for 10 years now has in addition a drinking-water system in which the proper quantity of salt is introduced mechanically. Thus, cool salt water may now be obtained by the workmen from the drinking fountains.

[1] Harrington, D., and Davenport, Sara J., Review of Literature on Conditioning Air for Advancement of Health and Safety in Mines: Bureau of Mines Inf. Circ. 7128, 1941, p. 88.

Although the statistics available on uses include farm consumption in the general break-down, uses for farms alone are not separated. It is well-known, however, that the largest part of the salt reported under evaporated- and rock-salt blocks is consumed on the farms and grazing ranges of the country, but a certain quantity is also used in prepared feed. In addition, food preparation requires considerable quantities in canning and preserving vegetables, fruits, and meats, as well as in baking and other cooking. Weed killers and insecticides also require salt. The quantity used as fertilizer is not definitely known. Salt derivatives certainly are fertilizer ingredients, but the effect of the application of salt directly on soils is still being studied. A recent report [2] recommends the use of common salt as a fertilizer in certain cases. When used in mixtures of phosphate and potash, the growth of certain vegetables and the keeping and eating qualities of celery were improved. Some crops showed no benefit, and some were injured. In the absence of potash fertilizers, salt was not beneficial. The benefits obtained were attributed to the sodium and not the chlorine. The Na ion appeared to be needed almost as much for a nutrient in the NaCl-responsive crops as was the K ion.

MARKETING

The pattern of marketing the salt of commerce probably has changed most on the eastern seaboard. As no salt deposits are known to be nearer than about 200 miles from the coast, such industries as fish curing and others in coastal areas sometimes have found it easier to use salt imported mainly from the West Indies. The submarine menace has made it increasingly impracticable to use boats to haul salt from the islands, and seaboard consumers are turning to sources within the United States and Canada. This did not apply so much in the early part of 1941 but became evident by the end of the year, and increased shipping difficulties were experienced early in 1942.

Prices.—New York prices quoted on rock and evaporated salt were firm throughout the year; changes were made only once or twice during 1941 and then chiefly in the price for less than carlots. Bagged rock salt in carlots, delivered at New York, was quoted at $13.70 a ton from January until June, when the price rose to $14.20, where it continued throughout the remainder of the year; in less than carlots, rock salt was quoted at $15.50 to $16.10 at the beginning of the year and advanced to $16 to $16.60 in June and to $17 to $18 in October, at which prices it held the rest of the year. Bagged vacuum fine salt was quoted at $15.70 a ton in carlots throughout the entire year; in less than carlots it was quoted at $16.60 to $19.70, changed in June to $18.20 to $21, and rose in October to $19.40 to $23.20, which was unchanged to the end of the year.

Demand for salt was steady, and shipments moved regularly throughout the year. In September there was an unusually early demand from municipalities for salt for ice control.

Market grades and packages.—As reported in Minerals Yearbook, Review of 1940, a committee of salt producers and distributors, in cooperation with the Division of Simplified Practice of the National Bureau of Standards, completed a revision of standards recommended

[2] Harmer, Paul M., and Benne, Erwin J., Effects of Applying Common Salt to a Muck Soil on the Yield, Composition, and Quality of Certain Vegetable Crops and on the Composition of the Soil Producing Them: Jour. Am. Soc. Agron., vol. 33, 1941, pp. 952–979.

for market grades and packages of salt and published its recommendation (R70) in March 1941. Because of the shortage of certain packing material in 1941, it has been impracticable to apply these recommendations, even in the simpler form that was entirely satisfactory to the industry when received; therefore, they have had to be modified somewhat and some of them discontinued (at least temporarily). In the classification for the larger part of the United States, about 15 of the various sizes and packages have been dropped tentatively, chiefly pockets and cotton and burlap bags although certain square cartons and the oval tin packages also are included in the elimination. In the Pacific Coast area, 13 packages of various kinds and capacities have been dropped, whereas 2 new packages for table salt have been added.

Although neither new nor included in the listed standard sizes, salt may be obtained also in canners' tablets in sizes ranging from 10 to 150 grains. They are dispensed electrically or mechanically, at a rate of as many as 180 to 200 tablets a minute.

Distribution of sales.—A majority of the salt producers were engaged in interstate business. Most of the plants that did no interstate business were producers of solar-evaporated salt, but several rock-salt producers were in this category. Brine was used close at hand at most plants, and none could be considered interstate trade in salt. Movement of evaporated and rock salt into the various States is shown in the following table.

Distribution (shipments) of evaporated and rock salt in the United States, 1940–41, by States of destination, in short tons

Destination	1940		1941	
	Evaporated	Rock	Evaporated	Rock
Alabama	6, 975	31, 253	7, 613	32, 790
Arizona	8, 957	2, 707	10, 350	3, 031
Arkansas	6, 159	21, 286	9, 262	26, 968
California	238, 675	6, 951	275, 417	29, 594
Colorado	25, 612	11, 671	29, 086	12, 774
Connecticut	13, 973	6, 008	16, 574	6, 796
Delaware	3, 697	29, 407	4, 599	23, 655
District of Columbia	4, 473	1, 339	5, 517	1, 511
Florida	6, 429	16, 706	6, 243	24, 389
Georgia	13, 489	43, 092	19, 145	50, 647
Idaho	9, 816	3, 698	11, 181	1, 398
Illinois	224, 514	134, 412	259, 413	163, 994
Indiana	63, 358	49, 451	80, 798	58, 066
Iowa	80, 600	86. 474	98, 653	88, 771
Kansas	36, 825	162, 612	39, 225	211, 447
Kentucky	34, 706	16, 897	38, 195	17, 654
Louisiana	5, 898	54, 683	4, 833	71, 012
Maine	7, 743	26, 346	10, 212	31, 476
Maryland	27, 527	23, 503	29, 977	26, 277
Massachusetts	51, 281	43, 999	64, 006	43, 266
Michigan	267, 733	55, 032	356, 194	60, 201
Minnesota	99, 323	63, 657	114, 029	66, 290
Mississippi	2, 652	27, 861	2, 624	31, 493
Missouri	63, 640	51, 609	76. 748	51, 991
Montana	15, 881	2, 718	17, 537	6, 494
Nebraska	25, 275	55, 616	30, 112	46, 171
Nevada	2, 009	243	3, 948	316
New Hampshire	6, 063	33, 074	8, 544	34, 330
New Jersey	72, 245	129, 842	83, 200	161, 044
New Mexico	5, 572	13, 244	7, 974	17, 548
New York	186, 377	386, 666	228. 127	449, 549
North Carolina	40, 861	44, 687	49, 257	55, 740
North Dakota	10, 105	4, 319	13, 225	4, 116
Ohio	148, 901	74, 332	201, 234	82, 333
Oklahoma	25, 877	27, 269	35, 080	33, 671
Oregon	23, 806	279	29, 354	123
Pennsylvania	121, 217	88, 320	156, 657	111, 306
Rhode Island	9, 091	9, 868	11, 760	10, 789

Distribution (shipments) of evaporated and rock salt in the United States, 1940–41, by States of destination, in short tons—Continued

Destination	1940		1941	
	Evaporated	Rock	Evaporated	Rock
South Carolina	9,024	14,375	8,584	17,673
South Dakota	14,615	14,732	16,209	11,483
Tennessee	22,304	41,838	22,558	47,547
Texas	46,284	144,204	244,055	166,452
Utah	14,625	3,793	14,902	3,218
Vermont	5,179	5,702	5,722	7,663
Virginia	46,536	44,061	57,585	50,120
Washington	108,070	682	116,187	538
West Virginia	165,999	47,291	171,727	60,980
Wisconsin	113,613	22,451	132,958	25,743
Wyoming	6,920	2,443	6,763	1,768
Other [1]	232,237	82,845	86,953	76,881
	2,782,741	2,265,548	3,330,106	2,619,087

[1] Includes production of Puerto Rico (evaporated salt); exports to Africa, Asia, Canada, Central America, Mexico, South America, West Indies, and other countries; shipments to Alaska, Hawaii, Puerto Rico, and Virgin Islands; and some shipments to unspecified destinations.

NEW SOURCES

With the exception of a few additional areas adjacent to those reported previously for Louisiana and Texas, no extensive discoveries of salt deposits in the United States have been reported beyond those shown on the map given in Minerals Yearbook, 1939 (p. 1358).

Directory changes.—Changes that have occurred since the directory of the salt industry was published in Minerals Yearbook, Review of 1940, are as follows:

New enterprises include the Desert Chemical Co. (4031 Goodwin Ave., Los Angeles, Calif.), which began operations at its Dale Lake plant at Twentynine Palms, Calif.; it made little production in 1941 but is looking to a larger output in 1942. The Dow Chemical Co. (Midland, Mich.) began to produce evaporated salt from Texas wells, for use electrolytically in the manufacture of magnesium metal from sea water at its Freeport (Tex.) plant. Bonneville, Ltd. (540 W. 7th St. S., Salt Lake City, Utah), began to produce solar-evaporated salt from the marshes at its Wendover plant in Tooele County, Utah. The Oklahoma Salt Industries Co. began to produce evaporated salt at its plant at Sayre, Beckham County, Okla. The Jefferson Island Salt Mining Co. (mine and refinery at New Iberia, Iberia Parish, La.) spent 9 months of 1941 building a new plant to replace the plant totally destroyed by fire in August 1940; in the last 3 months of the year the company mined and sold rock salt and pressed blocks made of rock salt, and it also made evaporated salt in vacuum pans but no pressed blocks from evaporated salt. The Avery plant of the International Salt Co. in Iberia Parish, La., added to its products in 1941 pressed blocks made from both rock and evaporated salt. The Morton Salt Co. (Chicago, Ill.) bought the rock-salt mine of the Crystal Salt Co. at Kanopolis, Ellsworth County, Kans., took possession in September 1941, and mined rock salt for the remainder of the year. The Crystal Salt Co. mined salt during the first 2 months of the year, then was idle for 7 months because of a caved shaft. Following the passage of a special leasing law by the Federal Government, the Metropolitan Water District of Southern California prepared to mine salt for treat-

ment of city water. In January 1942 the water district obtained two permits to mine salt from a large deposit on the public domain in San Bernardino County. None of the salt produced will be sold. Several salt companies were idle in 1941 because of too much rain or other reasons.

IMPORTS AND EXPORTS [3]

Salt imported for consumption in the United States, 1937–41, by classes

Year	In bags, sacks, barrels, or other packages (dutiable)		Bulk			
			Dutiable		Free (used in curing fish)	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	802	$8,008	24,115	$80,248	21,079	$45,106
1938	654	8,228	17,849	45,897	[1] 21,010	[1] 47,800
1939	2,121	14,977	28,451	58,540	15,461	27,700
1940	1,024	6,601	16,413	59,029	[1] 12,965	[1] 25,174
1941 (Jan.–Sept.)	915	9,300	5,870	13,331	4,820	16,421

[1] Includes salt in bags, sacks, barrels, or other packages, as follows: 1938, 93 tons, valued at $673; 1940, 6 tons, $12; 1937, 1939, and 1941, none reported.

Salt imported for consumption in the United States, 1940–41, by countries

Country	1940		1941 (Jan.–Sept.)	
	Short tons	Value	Short tons	Value
North America:				
Canada	3,818	$10,548	5,939	$17,075
West Indies:				
British:				
Jamaica	10,972	22,788	1,137	5,876
Other British	15,481	55,575	4,434	14,604
Netherlands: Curaçao	40	121	28	63
Europe: United Kingdom	91	1,772	67	1,434
	30,402	90,804	11,605	39,052

Salt exported from the United States, 1937–41

Year	Short tons	Value	Year	Short tons	Value
1937	70,111	$514,858	1940	147,044	$699,340
1938	67,498	469,708	1941 (Jan.–Sept.)	87,807	575,988
1939	124,273	610,501			

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

WORLD PRODUCTION

World production of salt, 1937–41, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941
North America:					
Canada	415,994	398,013	385,550	420,974	508,774
Costa Rica	4,287	4,740	6,822	(2)	6,000
Dominican Republic	(2)	9,286	9,536	7,500	14,700
Guatemala	12,610	10,465	(2)	(2)	(2)
Mexico	82,876	107,701	(2)	(2)	(2)
Panama	6,898	3,332	4,536	5,199	(2)
United States:					
Rock salt	1,841,967	1,725,330	1,846,254	2,055,260	2,375,983
Other salt	6,541,795	5,555,486	6,570,481	7,343,089	9,163,917
West Indies:					
British:					
Bahamas	2,000	17,900	11,600	27,000	25,400
Turks and Caicos Islands (exports)	50,833	35,578	47,389	67,028	48,179
Cuba	36,806	57,970	113,398	113,398	(2)
Netherlands (exports)	2,337	2,013	(2)	(2)	(2)
South America:					
Argentina (railway shipments)	290,084	264,150	303,321	292,307	(2)
Brazil	770,403	788,218	502,203	(2)	550,000
Chile	36,697	27,772	(2)	44,317	(2)
Colombia:					
Rock salt	4,211	4,010	(2)	(2)	(2)
Other salt	184,609	199,022	218,134	228,750	(2)
Ecuador:					
Rock salt	138	—	—	(2)	—
Other salt	13,800	13,800	16,145	29,900	20,207
Peru	39,010	38,451	39,669	41,326	46,707
Venezuela	26,298	22,658	20,473	52,540	(2)
Europe:					
Bulgaria:					
Rock salt	9,745	10,242	13,168	15,000	(2)
Other salt	43,602	66,258	(2)	65,000	(2)
Czechoslovakia	165,898	174,000	(2)	(2)	(2)
France:					
Rock salt and salt from springs	1,847,179	1,264,230	(2)	(2)	(2)
Other salt	490,906	346,046	(2)	(2)	(2)
Germany:					
Rock salt	2,757,242	2,694,984	(2)	(2)	(2)
Other salt	608,046	585,326	(2)	(2)	(2)
Austria:					
Rock salt	908	786	(2)	(2)	(2)
Other salt	169,883	93,576	(2)	(2)	(2)
Greece	102,285	102,057	(2)	(2)	(2)
Italy:					
Rock salt	603,798	613,870	(2)	(2)	(2)
Other salt	952,655	885,205	(2)	(2)	(2)
Malta	1,829	1,523	1,753	(2)	(2)
Netherlands: Rock salt	132,430	164,266	(2)	(2)	(2)
Poland	602,746	642,875	(2)	(2)	(2)
Portugal (exports)	4,633	6,096	9,289	11,955	(2)
Rumania:					
Rock salt	308,882	350,618	(2)	(2)	(2)
Other salt	2,077	1,140	(2)	(2)	(2)
Spain:					
Rock salt	29,673	150,878	(2)	(2)	(2)
Other salt	120,175	102,671	(2)	(2)	(2)
Switzerland	81,969	84,049	90,000	77,000	(2)
United Kingdom:					
Great Britain:					
Rock salt	18,666	19,974	(2)	(2)	(2)
Other salt	3,101,511	2,651,939	(2)	(2)	(2)
Ireland, Northern:					
Rock salt	4,254	2,362	(2)	(2)	(2)
Other salt	8,818	5,757	(2)	(2)	(2)
Yugoslavia	46,323	52,634	54,213	(2)	(2)
Asia:					
Aden	360,866	282,510	294,077	258,714	(2)
Burma	54,677	39,319	(2)	(2)	(2)
Ceylon	38,815	36,490	37,556	29,973	(2)
China (including Manchuria) [3]	3,000,000	3,000,000	3,000,000	3,000,000	(2)
Chosen [3]	138,000	138,000	138,000	138,000	(2)
Cyprus [3]	3,000	3,000	3,000	3,000	(2)

See footnotes at end of table.

World production of salt, 1937–41, by countries, in metric tons—Continued

Country	1937	1938	1939	1940	1941
Asia—Continued.					
India:					
British:					
Rock salt	190,103	191,395	196,505	([2])	([2])
Other salt	1,516,984	1,372,979	1,326,544	([2])	([2])
Portuguese	26,095	29,527	27,979	38,564	([2])
Indochina	193,558	193,050	213,526	166,000	([2])
Iraq	1,810	7,907	9,107	8,779	([2])
Japan:					
Japan proper [4]	535,775	([2])	([2])	([2])	([2])
Taiwan	210,471	([2])	([2])	([2])	([2])
Netherlands Indies	75,780	90,909	[5] 141,208	[5] 388,837	([2])
Palestine:					
Rock salt	727	444	645	599	([2])
Other salt	11,717	8,065	8,736	9,944	([2])
Philippine Islands	48,905	([2])	([2])	([2])	([2])
Syria [3]	10,000	10,000	10,000	10,000	([2])
Thailand (exports)	107,731	156,268	95,170	112,197	([2])
Turkey	262,226	247,293	([2])	([2])	([2])
Africa:					
Algeria	63,767	74,630	([2])	([2])	([2])
Belgian Congo	1,004	1,013	([2])	1,038	([2])
Canary Islands [3]	2,000	2,000	2,000	2,000	([2])
Egypt (exports)	276,735	284,949	442,532	([2])	([2])
Ethiopia: Rock salt [3]	10,000	10,000	10,000	10,000	([2])
French West Africa (exports)	643	51	([2])	([2])	([2])
Kenya Colony		3,250	([2])	9,425	([2])
Libya (Italian Africa):					
Cyrenaica [3]	10,000	10,000	10,000	10,000	([2])
Tripolitania [3]	20,000	20,000	20,000	20,000	([2])
Mauritius [3]	1,500	1,500	1,500	1,500	([2])
Morocco, French	11,207	909	([2])	([2])	([2])
Nigeria [3]	400	400	400	400	([2])
Portuguese East Africa	2,605	6,448	6,628	251	([2])
Portuguese West Africa (Angola) [3]	25,000	25,000	25,000	25,000	([2])
Somaliland:					
British (exports)	950	353	([2])	([2])	([2])
French (exports)	85,273	([2])	([2])	([2])	([2])
South-West Africa:					
Rock salt	669	641	751	1,125	[6] 671
Other salt	3,443	4,431	4,704	5,364	[6] 3,445
Sudan, Anglo-Egyptian	34,553	37,532	40,633	40,471	([2])
Tanganyika Territory	8,723	9,678	9,472	9,505	([2])
Tunisia	129,708	129,287	([2])	([2])	([2])
Uganda	3,133	3,169	2,626	3,374	([2])
Union of South Africa	106,338	117,717	([2])	([2])	([2])
Oceania:					
Australia:					
South Australia	74,739	76,013	80,759	146,991	([2])
Western Australia	3,729	3,850	([2])	([2])	([2])

[1] In addition to the countries listed, salt is produced in Albania, Bolivia, Eritrea, Gold Coast, Leeward Islands, Madagascar, Southern Rhodesia, U. S. S. R., and Victoria (Australia), but figures of production are not available.
[2] Data not available.
[3] Estimated annual production.
[4] Year ended Mar. 31 of year following that stated. The figures do not include output from salt beds which, although situated on Government beach lands, have no fixed areas.
[5] Incomplete data.
[6] January to June, inclusive.

MAGNESIUM COMPOUNDS AND MISCELLANEOUS SALINES

By Alvin Schallis and K. G. Warner [1]

SUMMARY OUTLINE

SUMMARY

The unprecedented activity of the United States in connection with the national defense program vastly increased the requirements for magnesia products during 1941. The manufacture of basic refractories was the chief use for magnesium compounds, but it is expected that before the end of 1942 their use in the manufacture of magnesium metal will be equally important. The Nevada magnesite industry is being rapidly expanded to huge proportions to supply in part requirements of magnesite for metal and refractory purposes. A flotation plant was installed at Chewelah, Wash., to increase production, reduce waste, and improve the quality of the products. Construction was begun in New Jersey on a plant to make refractory magnesia from sea water and dolomite, and other plants to use similar processes for supplying high purity magnesia to reduction plants were contemplated for the California coast. Several refractory plants that will use natural brines as sources of magnesia were being constructed during 1941, and additional plants of similar nature were planned. Dolomite, already the raw material in several plants manufacturing high-magnesia refractories, is the scheduled raw material for nine magnesium-metal plants now under construction. The further use of dolomite in the manufacture of magnesia refractories is likewise considered. Natural brines rich in magnesium compounds, which were discovered recently in Michigan and Texas, as well as the hitherto wasted magnesium chloride byproduct from the reaction between langbeinite and sylvite in New Mexico, were welcome sources of raw materials for proposed magnesium-metal plants. The output to be obtained from all of these new facilities, plus that from previously existing plants, will be used almost exclusively in the production of munitions.

The demand for salines followed the general trend of business to increased levels. The production of bromine and bromine compounds, largely used in the manufacture of the antiknock fluids added to gasoline, continued to increase during 1941. The new magnesium plant of the Dow Chemical Co. at Freeport, Tex., became another important

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

producer of Ethyl-Dow ethylene dibromide in 1941. The Desert Chemical Co. produced sodium sulfate products in its newly completed plant at Dale Lake, Calif., and the Washington Chemical Co. built a plant at Monse, Wash., to recover sodium sulfate from four deposits in that area. The need for additional soda ash production capacity has focused attention upon the natural sources of this commodity. A huge chemical industry based upon large deposits of trona recently discovered in southwestern Wyoming has been proposed, and exploratory work on this project is now under way. Substitution of enamel and ceramic ware for metals and alloys needed for war purposes greatly increased the requirements for borates. A prolonged strike at the American Potash & Chemical Corporation plant at Trona, Calif., caused a serious shortage of boron compounds during 1941, but the situation cleared after the men went back to work.

MAGNESIUM COMPOUNDS

MAGNESITE

Spurred by emergency conditions during 1941, domestic magnesite production advanced 12 percent over the 1940 production level to reach a new high of 374,799 short tons. The intense activity of the metallurgical industries and the greatly increasing demands for magnesium oxychloride cements taxed productive facilities of the magnesite producers to the limit. In addition to the unprecedented requirements of magnesite for long-established outlets, substantial quantities of magnesite were required for magnesium-metal production during 1941, and it is estimated that before the end of 1942 magnesite will be consumed in this application at the rate of more than 200,000 tons annually. Owing to the essential nature of these requirements and the threat of insufficient supplies, magnesite was placed on the critical list of essential materials on March 6, 1942.

Sales of dead-burned magnesite (not including refractory magnesia from sources other than magnesite) increased somewhat in 1941 over the 1940 level and totaled 135,956 short tons. Increased production activity of the steel industry was largely responsible for this increase, although new open-hearth furnace construction, increased application of basic refractories in steel production, and expanded industrial activity also played important roles. The use of refractory magnesia to replace imported refractory chromite has been considered, but it seems as yet to be merely a future possibility, inasmuch as adequate supplies of refractory-grade chromite are apparently readily available from Cuba.

Sales of caustic calcined magnesite rose sharply during 1941, reaching 30,225 short tons, an 86-percent gain over sales in 1940. Oxychloride cements for production of ship flooring consumed the greatest quantity of caustic calcined magnesite, although important increases in quantities used in rubber, rayon manufacture, and leather tanning were reported. Substantial quantities were likewise reported to have been used in the manufacture of magnesium metal; this use for caustic calcined magnesite will be vastly expanded in the near future by the construction of huge magnesium-metal plants in the West.

Salient statistics of the magnesite industry in the United States, 1937–41

	1937	1938	1939	1940	1941
Crude:					
Mined:					
Short tons	203,437	[1] 97,000	[1] 198,980	[1] 333,166	374,799
Value [1]	$1,483,492	$725,000	$1,465,190	$2,487,969	$2,655,547
Sold by producers:					
Short tons	1,952	919	1,123	2,133	4,536
Value	$29,203	$12,332	$15,752	$32,810	$54,045
Average per ton [2]	$14.96	$13.42	$14.03	$15.38	$11.91
Imports for consumption:					
Short tons	34	36	569	22	----------
Value	$313	$777	$5,456	$761	----------
Apparent new supply .... short tons	1,986	955	1,692	2,155	4,536
Percent domestic	98 2	96.2	66.4	99.0	100.0
Caustic calcined:					
Sold by producers:					
Short tons	10,031	7,400	10,157	16,261	30,225
Value	$311,326	$228,498	$310,102	$512,607	$1,052,077
Average per ton [2]	$31.04	$30.88	$30.53	$31.52	$34.81
Imports for consumption:					
Short tons	2,798	1,452	2,218	928	[3] 527
Value	$62,420	$39,551	$51,884	$21,301	[3] $11,538
Apparent new supply .... short tons	12,829	8,852	12,375	17,189	(4)
Percent domestic	78.2	83.6	82.1	94.6	(4)
Refractory magnesia:					
Sold by producers: [5]					
Short tons	83,204	38,738	86,077	140,668	201,481
Value	$1,598,336	$730,978	$1,699,723	$2,802,537	$5,052,879
Average per ton [2]	$19.21	$18.87	$19.75	$19.92	$25.08
Imports for consumption:					
Short tons	56,020	24,990	44,420	30,951	[3] 36,574
Value	$795,047	$371,669	$800,664	$551,536	[3] $802,844
Apparent new supply .... short tons	139,224	63,728	130,497	171,619	(4)
Percent domestic	59.8	60.8	66.0	82.0	(4)

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.
[2] Average receipts f. o. b. mine shipping point.
[3] Figures cover January to September, inclusive.
[4] Figures not available for publication.
[5] 1937–40: Includes dead-burned magnesite and refractory magnesia from sea-water bitterns; 1941: Includes dead-burned magnesite and refractory magnésia from sea-water bitterns, brucite, and dolomite.

The Northwest Magnesite Co. (Farmers Bank Bldg., Pittsburgh, Pa.) operated five or all of its six kilns at Chewelah, Wash., throughout 1941 and in December began to operate a new kiln having a daily capacity of 100 to 150 tons of dead-burned magnesite. A 300-ton-per-day flotation plant, which operates on a process developed in cooperation with the Bureau of Mines, was completed in June 1941, and test operation to determine the best commercial application of this equipment has since been under way. A preliminary geological report of the magnesite deposits of Stevens County, Wash., has been published by Bennett.[2] Figure 1 gives the location of magnesite and brucite mines, mills, and prospects.

The Westvaco Chlorine Products Corporation (405 Lexington Ave., New York, N. Y.) operated its Patterson and Newark plants (in California) at capacity during 1941. The Patterson plant processed magnesite mined at the Bald Eagle mine near Gustine, Calif., and at the Western mine above Livermore, Calif. (both owned and operated by the company), as well as ore shipped from Nevada. Magnesite from the Luning district—principal source of magnesite in Nevada—

[2] Bennett, W. A. G., Preliminary Report on Magnesite Deposits of Stevens County, Wash.: Washington Dept. of Conservation and Development, Div. of Geol., Rept. of Investigations 5, 1941, 25 pp.

was supplied by the Barium Products Co., Ltd., to the Newark (Calif.) plant of the Westvaco Chlorine Products Corporation until July 26, 1941. After that date the Sierra Magnesite Co.—a company in which the interests of the Todd-California Ship Building Corporation and the Westvaco Chlorine Products Corporation are joined—took over the magnesite-mining operations of the Barium Products Co., Ltd., in supplying magnesite to its parent companies. Relatively minor amounts of magnesite were furnished to the California plants of the Westvaco Chlorine Products Corporation from the East Ely mine in eastern Nevada.

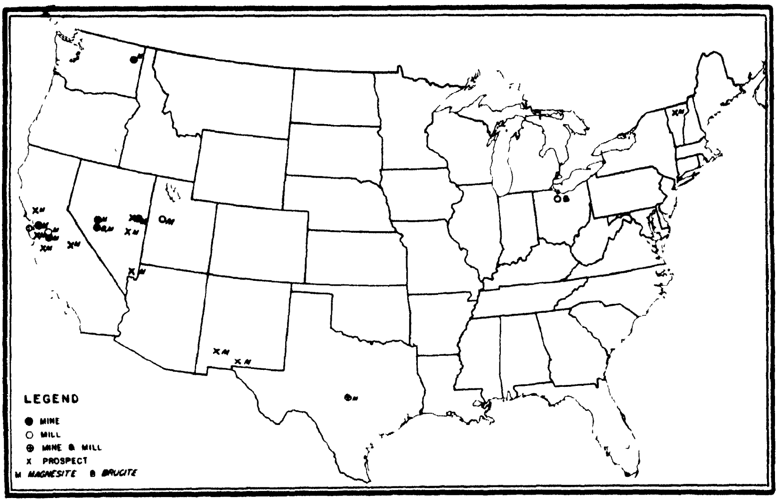

FIGURE 1.—Geographic distribution of magnesite and brucite mines, mills, and prospects in the United States.

The production of magnesite in Nevada increased greatly during 1941. In addition to the large shipments made by the Sierra Magnesite Co. to the magnesium-metal-producing plant of the Permanente Corporation and to the calcining and processing plants of the Westvaco Chlorine Products Corporation, substantially increased production of magnesite and brucite was reported by Basic Ores, Inc., subsidiary of Basic Refractories, Inc. (454 Hanna Bldg., Cleveland, Ohio), during 1941. Basic Magnesium, Inc., also a subsidiary of Basic Refractories, Inc., was organized during the year and has started construction of a $3,000,000 plant designed to produce and process 2,000 tons of magnesite a day; this plant will include crushing, grinding, flotation, and calcining units and is expected to be completed by December 1942. Products from this area must be trucked 32 miles to Luning, Nev., nearest rail shipping point. Magnesia produced by Basic Magnesium, Inc., will be sent to Las Vegas, Nev., to be converted into magnesium metal.

In a paper read before the Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers at Rolla, Mo., October 1941, Max Y. Seaton discussed the magnesite holdings near Luning, Nev.:

As there has been a considerable amount of confusion in published statements with reference to holdings in the district, it may be well to briefly clarify them. The oldest interests are those of the U. S. Brucite Co., whose property apparently

contains the principal deposit of brucite, together with large tonnages of magnesite. This property is leased to Basic Ores, Inc., a subsidiary of Basic Refractories, Inc., of Cleveland. Under this lease, U. S. Brucite retains the rights to magnesium-containing materials used for other than refractory purposes. In addition to Basic Ores' leasehold of the property mentioned, it holds, as mineral claims or as patented mineral land, a substantially larger area than that comprising U. S. Brucite's holdings. Much of this land contains showings of magnesite, and certain proportions of it are under active development at the present time. The third holder of property in the district is the Nevada Massachusetts Co. (including the interests of Charles Segerstrom and Frederick Thornton). The so-called Segerstrom property, a relatively small but extremely rich area, is a section originally prospected for tungsten and is under lease to the Sierra Magnesite Co., which is a corporation in which the interests of Henry J. Kaiser and his associates and Westvaco Chlorine Products Corporation are joined. The Sierra Magnesite Co.'s operations are directed toward supplying both the needs of Kaiser and Westvaco for magnesite ore. The fourth holder of properties near Luning is the Standard Slag Co. of Youngstown. Its property is substantially smaller than the U. S. Brucite's holdings but probably contains at least some brucite in addition to much medium-grade magnesite. In the condensed description above, some general idea as to the areas of the various holdings has been suggested; relatively exact knowledge as to ore reserves exists only with reference to the brucite on the U. S. Brucite Corporation's claims and with reference to magnesite on a small portion of the Segerstrom property. Data are not yet available to indicate the relative tonnages of usable ore likely to occur in the four properties in this district.

Two companies reported production of magnesite from the Llano district of Texas and one from Juab County, Utah, during 1941. Consideration has been given to the production of refractory magnesia from a high-grade magnesite deposit in the Burro Mountains about 35 miles northeast of Lordsburg in southwestern New Mexico. The deposit is reported to consist of three veins, each 14 feet wide and 1,500 feet on the strike. A typical analysis of the crude magnesite indicates the presence of 41.31 percent MgO, 1.55 percent CaO, 1.07 percent SiO_2, 0.32 percent Fe_2O_3, 0.43 percent Al_2O_3, and 55.32 percent ignition loss. A corresponding analysis of the calcined material indicates 92.46 percent MgO, 3.47 percent CaO, 2.39 percent SiO_2, 0.72 percent Fe_2O_3, and 0.96 percent Al_2O_3.

In the Federal District Court for the Southern District of New York, on July 22, 1941, four corporations and seven individuals were assessed fines totaling $76,500 for violation of the antitrust laws in the production and sale of magnesite and magnesite brick. The indictment returned on January 20, 1941, charged the Harbison-Walker Refractories Co., General Refractories Co., American-Austrian Magnesite Corporation, and Austrian Magnesite Co., Ltd., with entering into contracts with a group of foreign companies whereby the world markets were so divided as to give each group exclusive territories without competition.

Several proposals for the recovery of Canadian magnesite were given serious consideration during 1941. The British Columbia Magnesium Co. was organized and has done considerable exploratory work on several hydromagnesite deposits in the Williams Lake district and in the Clinton district of British Columbia. The concentration of magnesitic dolomite from Kilmar, Quebec, by flotation processes was studied by the Canadian Department of Mines and Resources.[8] Magnesite recoveries of 50 to 60 percent, having a lime content of 2.0 to 4.5 percent, depending on the nature of the feed, were obtained

[8] Canadian Mining Journal, The Concentration of Magnesitic Dolomite from Kilmar, Quebec, Magnesite Recoveries Bears Relation to Lime Content of Native Rock: Vol. 63, No. 3, March 1942, pp. 157–165.

from feeds containing 13 percent lime and 46 percent magnesite. The reagents used were soda ash, quebracho extract, oleic acid, and American Cyanamid frother No. 60. A brief review of the Canadian resources of magnesite, as well as other sources of magnesia including brucite, dolomite, magnesitic dolomite, magnesium silicates, brines, and salines is given in a recent article by Goudge.[4]

Owing to the cessation of imports from Axis-controlled countries, considerable interest was attached to the development of sources of magnesite in Latin America. Two large deposits of satisfactory-grade magnesite occur near Brumado in the southwestern part of the State of Baía, Brazil. Adequate transportation facilities are, however, lacking, and several years would be required for large-scale production to be realized. Perhaps of more interest is the discovery of high-grade magnesite in northeastern Honduras. This deposit, reported to be large, is fairly accessible to the railroad. The importation of crude magnesite from Santa Margarita Island off the west coast of Lower California, Mexico, to be calcined at Chula Vista, Calif., has been proposed. The present duty of $9.375 per short ton on imported crude magnesite, however, makes such an operation uneconomical. A relatively large deposit of good-grade magnesite near Gatooma, Southern Rhodesia, has likewise been suggested as a source of magnesite for export both to the United States and to England. The critical lack of available shipping facilities, however, makes this, as well as magnesite deposits in Latin America, of doubtful value at present.

The maximum price of the maintenance grade of domestic grain magnesite in bulk, f. o. b. Chewelah, Wash., was established at $22 a ton on January 28, 1942, by the Office of Price Administration. For carlots of the product, in bags or sacks, the price established was $4 above the ceiling price for magnesite sold in bulk. The maximum price established by the schedule was that which had prevailed for the previous 3 years. On March 6, 1942, however, some sales of dead-burned grain magnesite at a maximum of $32 per ton f. o. b. California shipping points were permitted to cover high-cost production necessitated by the great wartime demand for refractory magnesite. Although only maintenance grades of dead-burned magnesite were covered by the price limitation, maximum price schedules were planned for other grades of magnesite and basic refractories. Prices of the chemical grade of domestic caustic calcined magnesite in bags, f. o. b. New York, N. Y., in less than carlots started a gradual increase in April 1941 and rose from $65 to $70 per ton to $83 to $88 per ton in April 1942, according to price quotations listed in the Oil, Paint and Drug Reporter. The corresponding price f. o. b. mines in California in April 1942 was $58.75 per ton.

REFRACTORY MAGNESIA FROM SOURCES OTHER THAN MAGNESITE

Sources of magnesia other than magnesite have gained importance rapidly. Almost 33 percent of the refractory magnesia produced in the United States during 1941 originated from these sources. Production of brucite by Basic Ores, Inc., from the Luning district of Nevada, only commercial source of brucite in the United States, reached a

[4] Goudge, M. F., Sources of Magnesia and Magnesium in Canada: Trans. Canadian Inst. Min. and Met., vol. 45, 1942, pp. 191-207

new high; the ore was shipped largely to the Maple Grove plant of Basic Refractories, Inc., of Cleveland, Ohio, to be combined with dolomite, iron oxide, and silica or silicates for the manufacture of a stabilized dolomitic refractory. The Aluminum Co. of Canada, Ltd., started to construct a plant at Wakefield, Quebec, for the recovery of magnesia from the extensive brucite deposits in the Gatineau River Valley some 14 miles northwest of Hull, Gatineau County, Quebec. The process to be used has been developed by the Canadian Department of Mines and Resources during the last 3 years. Other large deposits of brucite have been found in and around BrysonTownship, Quebec, and in the vicinity of Rutherglen, Ontario. Consideration has been given to the plan to use brucite from these deposits for the manufacture of magnesium metal as well as of basic refractories.

Other sources of magnesia also were actively exploited during 1941. The Newark (Calif.) plant of the Westvaco Chlorine Products Corporation operated at capacity, preparing high-grade magnesia products from sea-water bitterns obtained from salt plants in the vicinity of San Francisco. Recent improvements in the plant have been described.[5] An important plant to be operated on sea-water bitterns is being constructed by the West Indies Sales Co. in the Bahama Islands to supplement domestic production of much-needed high-grade refractory magnesia.

Owing to the high purity of the magnesia required for magnesium-metal production, considerable quantities of the raw material required for this purpose have been supplied from the Newark sea-water product in an exchange agreement between the Permanente Corporation and the Westvaco Chlorine Products Corporation. Moreover, at least one plant to produce additional magnesia from raw sea water and dolomite is being constructed on the California coast.

Late in 1941 the Northwest Magnesite Co. announced plans for the construction, at Cape May, N. J., of a refractory magnesia plant which is to use dolomite (shipped from near Philadelphia) and raw sea water as sources of magnesia. This plant is designed to produce about 40,000 tons of refractory magnesia a year, but provisions have been made for the addition of more units. Priorities have been granted for the materials used in its construction, which is being financed entirely by the Northwest Magnesite Co., and it is expected to be completed during July 1942. In the process to be used here and at the plants on the California coast, the calcium hydroxide of milk of dolomite is used to precipitate magnesium hydroxide from the magnesium chloride in sea water. The precipitated magnesium hydroxide and the unreacted magnesium hydroxide from the milk of dolomite are settled, filtered, and calcined to yield the desired products. This magnesia contains as impurities small quantities of lime that do not react completely with the magnesium chloride or are carbonated by the atmosphere, all the siliceous impurities in the milk of dolomite, and quantities of reagents (such as iron oxide) added for their modifying effects in processing. Developments similar to these are occurring throughout the world.

Recovery of magnesia from natural brines is also increasing. The Michigan Chemical Co. is constructing a plant at Saint Louis, Mich.,

[5] Pit and Quarry, Sea-Water Magnesite Plant Improved: Vol. 33, No. 10, 1941, pp. 45, 47.

which is expected to yield 15,000 tons of refractory magnesia from dolomite and from natural brines in that area. Completion of this plant is expected during the latter half of 1942. It is reported that refractory magnesia is to be recovered from the magnesium content of the brines of Great Salt Lake in Utah. The salt content of the lake ranges from 14 to almost 28 percent, depending on the level of the lake, and is composed of 55.5 percent chloride ions, 6.6 percent sulfate ions, 33.4 percent sodium ions, 1.9 percent potassium ions, 2.3 percent magnesium ions, and 0.3 percent calcium ions. Precipitated gypsum undoubtedly would be a byproduct of the operation.

Increased production of magnesia from dolomite was recorded during 1941. The Standard Lime & Stone Co. of Baltimore, Md., operated its process at capacity during the year, leaching calcium hydroxide from milk of dolomite to produce a high-MgO product for refractory use. The Diamond Alkali Co., in cooperation with Basic Refractories, Inc., is reported to have produced a limited quantity of magnesia from calcined dolomite by treating this material in its ammonia stills. The bulk of the magnesia so recovered was said to have been shipped to the Maple Grove (Ohio) plant of Basic Refractories, Inc., for conversion to refractory products. The Diamond Alkali Co. will utilize this operation as part of its process for the manufacture of magnesium metal.

Basic Refractories, Inc., continued to manufacture its stabilized dolomitic refractory from dolomite, brucite, silica or magnesium silicates, iron oxide, and other components. Although this product contains only 65 percent magnesia, it competes directly with dead-burned magnesite for many uses and may therefore be considered in this discussion of refractory magnesias from sources other than magnesite.

The Warner Co. of Philadelphia, Pa., continued work in the pilot plant on methods of recovering magnesia from dolomite by dissolving the calcium content as calcium bisulfide with hydrogen sulfide. Owing to the urgent need for high-grade refractory magnesia, a large commercial plant to use this process is being constructed. MacIntire,[6] working for the American Lead, Zinc & Smelting Co., patented a process for recovering magnesia from dolomite. His process involves treating half-burned dolomite with water and hydrogen sulfide to form a solution of magnesium bisulfide. The calcium carbonate is removed, and magnesium hydroxide and hydrogen sulfide are recovered by boiling the solution. Stump [7] patented a method of differentially carbonating a milk of dolomite in such a way that only the $Ca(OH)_2$ is carbonated, whereas the $Mg(OH)_2$ is left unaffected. The calcium carbonate and magnesium hydroxide are separated by mechanical means.

The possibility of using magnesium silicates in the manufacture of magnesia attracted increasing attention during 1941. Olivine has been used for several years in the manufacture of Epsom salts on a small scale, and much experimentation has indicated the feasibility of using olivine and serpentine in the manufacture of magnesium metal. H. R. Brandenburg [8] has patented a process for obtaining

[6] MacIntire, W. H., Magnesium Oxide from Dolomitic Rock: U. S. Patent 2,118,353, May 24, 1938.
[7] Stump, Horace, E., Carbonating Lime and Separating it from Magnesia: U. S. Patent 2,231,965, February 18, 1941.
[8] Brandenburg, H. R., Magnesium Oxide Recovery from Serpentine: U. S. Patent 2, 210,892, August 6, 1940.

magnesia from serpentine. In this process, serpentine calcined at about 700° C. is leached with water and carbon dioxide to form magnesium bicarbonate. Magnesia is obtained by calcining the precipitated basic magnesium carbonate resulting from heating the solution of magnesium bicarbonate. About one-third of the magnesium in serpentine may be recovered in this manner.

DOLOMITE

Responding to the demands of the steel industry, sales of dead-burned dolomite by domestic producers advanced 23 percent over the 1940 level to a new high of 1,069,887 short tons. Most refractory dolomite plants were operated at or near capacity, and increased production facilities seemed to be needed in some places. As in 1940, no imports of dead-burned dolomite into the United States were reported. The year 1941 was marked by an increased use of dolomite as a source of magnesia. As noted in the preceding section on Refractory Magnesia from Sources Other than Magnesite, two companies utilized dolomite for the manufacture of refractory magnesia, and several more were constructing plants or studying processes for that purpose. However, the various magnesium-metal plants now under construction probably will consume far more calcined dolomite than those in which refractory magnesias are or will be produced.

Dead-burned dolomite sold in and imported into the United States, 1937–41

Year	Sales		Imports [1]		Year	Sales		Imports [1]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1937	617,706	$5,217,833	9,083	$231,084	1940	867,909	$6,925,328		
1938	366,626	3,095,355	2,875	67,340	1941	1,069,887	9,111,172		
1939	671,561	5,447,554	186	4,260					

[1] Reported as "dead-burned basic refractory material."

Nine plants that will use dolomite in the production of magnesium are now under construction. The processes to be used are described in some detail in the Magnesium chapter of this volume. Estimates place the total calcined dolomite to be used in the war program for production of magnesium metal at nearly 600,000 tons annually. Important as this quantity may be, however, it is less than that used for refractory purposes in normal peace times.

An interesting information circular on dolomite was published by the Bureau of Mines.[9] This paper discusses most of the uses of dolomite in some detail and also indicates the location of the principal deposits from which dolomite has been recovered. Another information circular dealing more particularly with the uses of dolomite in the chemical and processing industries was also published by the Bureau of Mines during 1941.[10]

[9] Colby, Shirley F., Occurrences and Uses of Dolomite in the United States: Bureau of Mines Inf. Circ. 7192, 1941, 21 pp.

[10] Bowles, Oliver, and Jensen, Mabel S., Limestone and Dolomite in the Chemical and Processing Industries: Bureau of Mines Inf. Circ. 7169, 1941, 15 pp.

OTHER MAGNESIUM COMPOUNDS

Production of magnesium compounds (other than magnesias similar to caustic calcined or dead-burned magnesite) from natural brines, bitterns, or saline deposits continued to expand and reached a new high level of 137,357 tons valued at $3,587,784 in 1941, a 27-percent increase in quantity over the previous high of 108,266 tons valued at $2,452,814 in 1940. The huge war demand for magnesium metal spurred the production of magnesium chloride and increased its lead over other magnesium compounds still further. Almost two-thirds of the projected 362,500 tons of annual magnesium-producing capacity for the war program will utilize electrolysis of magnesium chloride. Adding other consumption of magnesium chloride to that for magnesium metal, the total will approach a million tons annually, which is many times the 1940 total. To produce the great tonnages of magnesium chloride required, operations of the Dow Chemical Co. at Midland, Mich., and at Freeport, Tex., and of the Westvaco Chlorine Products Corporation at Chula Vista, Calif., were maintained at capacity during the year.

Magnesium compounds imported for consumption in the United States, 1937–41

Year	Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (Epsom salts)		Calcined magnesium sulfate or calcined kieserite (not fertilizer)		Oxide or calcined magnesia	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	32	$1,120	1,953	$26,771	4,117	$71,889	109	$35,643
1938	41	1,572	799	12,328	3,193	66,470	46	15,947
1939	28	960	198	3,641	2,472	43,435	38	14,755
1940	(1)	21	6	898			18	5,672
1941 (Jan.–Sept.)	3	318	1	170			6	2,142

Year	Magnesium carbonate, precipitated		Manufactures of carbonate of magnesia		Magnesium salts and compounds, n. s. p. f.[2]	
	Short tons	Value	Short tons	Value	Short tons	Value
1937	521	$51,684	7	$562	70	$20,462
1938	470	53,151	3	209	48	17,146
1939	776	68,934			59	26,788
1940	754	82,764			92	44,492
1941 (Jan.–Sept.)	634	74,994			19	8,861

[1] 109 pounds.
[2] Magnesium silicofluoride or fluosilicate included under "Magnesium salts and compounds, n. s. p. f."

The Bureau of Mines is conducting exploratory work to determine the feasibility of a plant to produce magnesium chloride from saline deposits at depths ranging from 2,200 to 4,200 feet near Thompsons, 30 miles north of Moab, Grand County, Utah. The brines are said to contain almost 32 percent solids that consist approximately of 52 percent magnesium chloride, 27 percent calcium chloride, 13 percent potassium chloride, and 8 percent sodium chloride; about 0.15 to 0.20 percent of bromine is also present. The erection of a plant capable of producing 500 tons of anhydrous magnesium chloride daily has been proposed. Bromine and potassium chloride also would be recovered.

Recently a large deposit of brine about three times as rich in magnesium salts as that used by the Dow Chemical Co. at its Midland (Mich.) plant has been discovered near Ludington, Mich. It is planned to use magnesium chloride extracted from this brine for the annual production of 72,000 tons of magnesium metal, most of which will be manufactured by the Dow Chemical Co.

The magnesium chloride obtained as a byproduct of the production of potassium sulfate by the Union Potash & Chemical Co., Carlsbad, N. Mex., subsidiary of the International Minerals & Chemical Co., is also to be used as a source of magnesium metal. Anhydrous magnesium chloride will be shipped to Austin, Tex., for conversion into metal. Additional metal will be produced at this plant from dolomite as raw material.

Production of magnesium chloride from other sources, notably dolomite and magnesium silicates, is expanding rapidly. Of the huge quantity of magnesium chloride needed for magnesium-metal production, over 200,000 tons will be derived from dolomite and additional quantities may be obtained from olivine and serpentine. The chapter on Magnesium in this volume contains further details concerning these developments.

Production of magnesium sulfate from natural brines increased substantially during 1941. Production was reported in Michigan, Texas, and Washington, with one plant in each State. The recovery of Epsom salts from Epso Lake in north central Washington by the C. A. Kearney Co. of Tonasket, Wash., has been discussed in Mining World, July 1941 (pp. 29–31).

Naturally occurring brines rich in magnesium sulfate found west of the Pecos River in Eddy County, southeastern New Mexico, were described by Lang.[11] These brines average 382 grams per liter solids content, of which 44 percent is magnesium sulfate, 39 percent sodium sulfate, 10 percent magnesium chloride, 4 percent potassium sulfate, 2 percent magnesium borate, and 1 percent magnesium carbonate. Interest was expressed in utilization of these brines as a source of raw material for magnesium-metal production.

Considerable expansion of the magnesium sulfate plant near Sylva, N. C., is contemplated, although no action was taken during 1941. This plant produces Epsom salts by the digestion of olivine with sulfuric acid, followed by leaching, purification, and crystallization of the magnesium sulfate so produced.

Methods for preparing magnesium sulfate by treatment of magnesium hydroxide and gypsum with CO_2 [12] and by calcination of a mixture of serpentine and iron pyrites [13] have been described. The first of these methods is carried out in an aqueous medium always containing some magnesium hydroxide rather than in a solution saturated with carbon dioxide. In the other method, only about one-third of the magnesium present in the serpentine may be recovered as magnesium sulfate.

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[11] Lang, Walter B., New Source for Sodium Sulfate in New Mexico: Bull. Am. Assoc. Petrol. Geol., vol. 25, No. 1, January 1941, pp. 152–160.

[12] Farnsworth, Wm. H., and Martin, Clair H., Magnesium Sulfate from Magnesium Carbonate and Calcium Sulfate: U. S. Patent 2,231,327, February 11, 1941.

[13] Brandenburg, Hellmuth R., Serpentine as a Source of Magnesia: Min. Jour. (Phoenix, Ariz.), vol. 24, No. 10, 1940, pp. 2–3.

A strong plaster, described by Cunningham,[14] has been prepared by heating gypsum in 30- to 35-percent magnesium sulfate solution at 265° F. for about 45 minutes. The calcium sulfate hemihydrate resulting from heat treatment of the gypsum is filtered from the Epsom salts solution and is washed, dried, and ground in a ball mill to produce a plaster holding 33 to 45 cc. of water per 100 grams and having a tensile strength when set of 490 pounds per square inch and a compressive strength of 4,610 pounds per square inch.

A series of British patents [15] on a new process for the recovery of magnesium compounds from sea water has been issued. The process involves precipitation of magnesium hydroxide from sea water in the usual manner, followed by dissolution of this precipitate with carbon dioxide under pressure. The resulting solution of magnesium bicarbonate is passed through a column of an organic cation-exchange material saturated with a sodium compound. This results in the formation of a solution of sodium bicarbonate from which sodium carbonate may be recovered. Magnesium chloride may be obtained by passing raw or treated sea water through the column saturated with magnesium ions. Magnesium sulfate may be obtained by treating the magnesium-saturated cation-exchange material with sulfuric acid followed by neutralization. Patents on pretreatment of sea water and on the precipitation of magnesium hydroxide and magnesium silicate are included in this series.

Prices of most magnesium compounds remained constant during 1941. Anhydrous magnesium chloride sold at 13 cents per pound delivered in barrels, while the price of flake magnesium chloride packed in barrels remained at $32.00 per ton, f. o. b. works. Technical Epsom salts sold at $1.80 per 100 pounds in bags. No changes in price occurred among the more usual grades of magnesium carbonate, oxide, or hydroxide.

A new magnesium mineral, bradleyite ($Na_3PO_4.MgCO_3$), was reported by Fahey and Tunell.[16] This mineral occurs as a 1-inch layer at a depth of 1,343 feet in the drill core in which the mineral shortite was found in Sweetwater County, Wyo.

CALCIUM CHLORIDE

Sales of calcium chloride and mixed calcium-magnesium chloride obtained from natural brines totaled 165,932 short tons in 1941, basis 75 percent (Ca, Mg) Cl_2, a 67-percent increase over the 1940 total, resulting largely from increased business activity noted generally throughout the Nation. Exports of calcium chloride in the first 9 months of 1941 were 15,961 short tons, or almost double the total for 1940. Customarily exports of calcium chloride, although having a wide distribution, go largely to Canada, Argentina, Venezuela, Cuba, Netherlands Indies, and Mexico.

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[14] Cunningham, W. A., A Strong Plaster for Paperless Wallboard. Rock Products, vol. 45, No. 4, April 1942, pp. 50-53; Schoch, E. P., Wall Plaster: U. S. Patent 1,989,712, February 5, 1935.

[15] Adams, Basil A. (assr. to Ocean Salts Products, Ltd.), Magnesium Sulfate from Magnesium Hydroxide Prepared from Sea Water: British Patent 532,786, January 30, 1941; Treatment of Sea Water and the Like: British Patent 533,509, August 8, 1939; Pure Magnesium Hydroxide: British Patent 535,852, September 20, 1939; Magnesium Silicate: British Patent 535,853, September 20, 1939; Producing Solutions of Alkali Compounds from Sea Water: British Patent 535,854, September 20, 1939; Magnesium Chloride: British Patent 536,266, November 13, 1939; Preparation of Magnesium Fluoride: British Patents 540,075 and 540,076, July 26, 1940.

[16] Fahey, Joseph J., and Tunell, Geo., Bradleyite, a New Mineral, Sodium Phosphate-Magnesium Carbonate: Am. Mineral., vol. 26, 1941, pp. 646-650.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1937–41

[In terms of 75 percent (Ca, Mg) Cl_2]

Year	Short tons	Value	Year	Short tons	Value
1937	97,142	$1,295,403	1940	[1] 99,536	[1] $998,241
1938	96,470	1,218,938	1941	165,932	1,333,370
1939	108,441	1,307,717			

[1] Revised figures

Calcium chloride imported for consumption in and exported from the United States, 1937–41

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1937	2,205	$24,908	21,731	$415,309
1938	1,642	21,174	24,118	396,981
1939	996	12,314	19,382	318,199
1940			8,907	194,738
1941 (January-September)	7	795	15,961	376,912

Calcium chloride is consumed chiefly in road stabilization, surface consolidation, and dust laying; other uses are for highway ice control, dust-proofing coke and coal, refrigeration, concrete acceleration and conditioning, manufacture of chemicals, and air conditioning. Substantially increased consumption for concrete acceleration and conditioning during 1941 resulted primarily from increased construction of defense projects. It is expected that the use of calcium chloride in dust- and freeze-proofing coal and dust-proofing coke will increase if oil-transportation difficulties cause increased utilization of coal for domestic heating purposes.

A new use for calcium chloride, and one that will doubtless become very important in the near future, is in conjunction with dolomite in the manufacture of magnesium metal by processes to be used by several alkali companies. It is estimated that the production of magnesium metal alone will consume about 300,000 tons of the equivalent of 75-percent calcium chloride annually before 1943.

Calcium chloride prices tended to decrease during 1941. Prices of flake calcium chloride of 77- to 80-percent concentration, which at the beginning of the year were quoted by the Oil, Paint and Drug Reporter at $20.50 to $35.00 per ton in carlots of material packed in drums, by the middle of June were quoted for material in paper bags because of increased package costs. Prices for calcium chloride in drums were $3.50 per ton more and those for calcium chloride in burlap bags $2.50 per ton more than for material in paper bags. Early in November the prices of calcium chloride in paper bags were reduced to the range of $18.50 to $35.00 per ton.

BROMINE

Production of bromine continued its phenomenal rise which began in 1926 by advancing 15 percent from its 1940 level to 34,159 short tons in 1941. The high pitch of business activity, involving increased consumption of gasoline of ever-improving antiknock rating, has been

chiefly responsible for this increase, although the expanding miscellaneous uses for bromine compounds have also played important roles. During 1941 bromine was produced in 14 plants distributed throughout the Nation, as follows: Michigan, 5; Ohio, 1; West Virginia, 4; California, 2; and North Carolina and Texas, 1 each.

The Ethyl-Dow plant at Freeport, Tex., was a very important new domestic producer of bromine, having gone into production in March 1941; it operates in conjunction with the Dow plant that produces magnesium metal at the same location. The bromine from the plant appears largely in the form of ethylene dibromide, a compound produced from the recovered bromine and the natural gas piped to the plant. The addition of this new plant to the Ethyl-Dow bromine-production facilities increases still further the already great fraction of the total domestic bromine production controlled by the company.

Bromine and bromine in compounds sold or used by producers in the United States, 1937-41

Year	Pounds	Value	Year	Pounds	Value
1937	26,200,256	$5,180,177	1940	59,266,275	$11,772,515
1938	33,324,116	6,610,056	1941	68,317,019	11,506,213
1939	37,882,005	7,611,400			

The process used by the American Potash & Chemical Corporation, another relatively new producer in the field, for recovering bromine is described in a recent patent.[17] It involves concentrating the raw brine from Searles Lake substantially to saturation with respect to potassium chloride and then cooling the liquor to separate mixed crystals of potassium chloride and of potassium bromide, which is isomorphous with it. Concentrations of potassium bromide as high as 1.8 percent of the crystalline product are obtained. These crystals are separated from the mother liquor and dissolved, and the solution is treated with chlorine to release the bromine, which is recovered by steam distillation. Pure potassium chloride is crystallized from the debrominated solution. Bromides will be prepared from bromine by a recent modification of the van der Meulen process,[18] in which bromine is reacted with a metal hydroxide or carbonate in the presence of an easily reduced material, yielding only water and gases as products of reduction.

By far the greatest part of the bromine manufactured in this country is used as ethylene dibromide in the preparation of ethyl fluid, which is added to gasolines to improve their antiknock qualities. Other important uses for bromine compounds are in photography, medicine, fumigation, and chemical synthesis. Although not yet used to an appreciable extent in World War II, many war gases and lachrymators contain bromine and consumed a very appreciable tonnage of bromine during World War I. Germany is reported to have large stores of poison gases on hand, and it is probable that other warring nations likewise are producing such weapons in appreciable quantities. Should

[17] Gale, Wm. A., and Pearson, E. P., Recovery of Bromine and Iodine from Brines Such as Searles Lake Brine: U. S. Patent 2,251,353, August 5, 1941.

[18] Meulen, J. H. van der, Alkali or Alkaline Earth Metal Bromides: U. S. Patent 1,775,598, September 9, 1930.

poison-gas warfare become active, large quantities of bromine doubtless would be necessary for the manufacture of the requisite gases and other chemical agents.

Some progress has been made in the problem of shipping elementary bromine. Under present practice, bromine is shipped in cases of nine glass bottles, each containing 6.5 pounds of bromine. The net weight of this unit is 58.5 pounds of bromine, and the gross weight is about 140 pounds. A recent German patent (No. 694,408) suggests packaging the bromine in light sheet-iron containers coated with lead and partly filled with tetramethyl-ammonium bromide. Bromine is added to this compound in the container to form a solid molecular compound, of which 93 percent is bromine. The containers are equipped with openings, and the bromine is introduced through tubes. When it is desired to remove the bromine, hot air or steam is injected, and at 40° C. the bromine melts and can be withdrawn, leaving the tetramethyl-ammonium bromide, which can be used again. It is claimed that by this means the packing weight may be reduced to one-tenth of its former poundage.

Bromine prices remained constant during 1941, being quoted at 25 to 30 cents per pound for the purified material in 1,000-pound cases.

IODINE

Production of iodine in the United States again increased during 1941. Current figures may not be published, however, owing to the fact that only the Dow Chemical Co. and the Deepwater Chemical Co. reported production. The domestic output of iodine during 1937 (the latest year for which statistics have been published by the Bureau of Mines) was 299,286 pounds valued at $242,422. Imports of crude iodine amounted to somewhat over 339 short tons in the first 9 months of 1941; however, they are not a reliable index of consumption or activity in the iodine industry in a given year. This is due to the relatively limited use of this commodity and to the fact that the Chilean Nitrate & Iodine Sales Corporation, only iodine-importing organization, maintains large stocks in this country.

Crude iodine imported for consumption in the United States, 1937–41

Year	Pounds	Value	Year	Pounds	Value
1937	1,967,148	$1,784,491	1940	1,244,146	$1,296,181
1938	570,532	464,303	1941 (Jan.-Sept.)	678,865	769,272
1939	200,000	168,238			

Prices of crude iodine were the same at the end of 1941 as at the beginning. On June 16, 1941, the Chilean Nitrate & Iodine Sales Corporation raised the price of crude iodine from $1.35 per pound to $1.60, but when domestic producers failed to follow this advance the importers soon were forced to restore their quotation to its former level.

Iodine is used chiefly in pharmacy and photography, in table salt, and as a mineral supplement to animal feeds. Factors responsible for loss of iodine from iodized salt and iodized feeding stuffs have been studied by the Iodine Educational Bureau in collaboration with the Mellon Institute for Industrial Research. It was found that iodized

salt may lose as much as 40 percent of its iodine content during 18 months' storage, and iodized-mineral feeding mixtures may lose 9 to 20 percent in 4 months. This loss, however, has been overcome by milling 10 percent of the stearate of either calcium or magnesium with 300-mesh potassium iodide before mixing with the salt or feeding compound. This process, which is now in commercial application, is said to impart great stability to the iodide in the presence of salt or mineral oxidizing agents but to leave the iodide in a completely assimilable form.

SODIUM SULFATES AND CARBONATES

Production of natural sodium sulfate reversed its upward trend by decreasing 16 percent from the 1940 level to 157,524 short tons in 1941 owing partly to a 3½-month strike at the plant of one of the principal producers. It has been estimated[19] that the total 1941 consumption of salt cake was 525,000 to 550,000 tons, an increase of some 100,000 tons over the preceding year. Extended use of paper, especially for packaging, was largely responsible for this gain. Imports of sodium sulfate (almost all salt cake) during the first 9 months of 1941 were 61,508 short tons valued at $664,985, indicating an increased over-all rate of importation despite cessation of imports from Continental Europe.

Natural sodium sulfates and sodium carbonates sold or used by producers in the United States, 1935–41

Year	Sodium sulfates[1]		Sodium carbonates[2]	
	Short tons	Value	Short tons	Value
1935	38,706	$275,943	93,230	$1,173,003
1936	51,608	336,559	102,866	1,106,364
1937	80,053	599,[illegible]66	104,711	1,191,485
1938	80,210	596,812	100,010	1,235,328
1939	137,479	1,027,876	1[illegible]4,743	1,528,810
1940	187,233	1,528,633	1[illegible]0,034	1,629,283
1941	157,524	1,443,137	146,677	1,822,986

[1] 1935–38: Salt cake and Glauber's salt; 1939–41: Salt cake, Glauber's salt, and burkeite.
[2] Soda ash, bicarbonate, and trona.

Commercial shipments of sodium sulfate products from the plant of the Desert Chemical Co. of Dale Lake, Calif., were begun in September 1941. This plant recovers sodium sulfate and sodium chloride from a subterranean brine lake containing 22.5 percent NaCl and 7.5 percent Na_2SO_4. Fractional crystallization, dependent on natural variations in climatic conditions, is used to effect separation of the constituents of the brine.

The American Potash & Chemical Corporation, Trona, Calif., already leading producer of natural sodium sulfate products, will increase its annual productive capacity for salt cake by 50,000 tons during 1942. The entire production of the company was halted for almost 15 weeks (from March 15 until July 1, 1941) by a strike of plant workers. The process used by this company has been interestingly described by Robertson.[20] Use is made of the phase-rule rela-

[19] Oil, Paint and Drug Reporter, Salt Cake: Vol. 141, No. 5, February 3, 1942, p. 38.
[20] Robertson, G. Ross, Expansion of the Trona Enterprise: Ind. and Eng. Chem., Ind. ed., vol. 34, No. 2, February 1942, pp. 133–137.

tionships between solutions of sodium chloride and the other salts involved, whereby sodium sulfate and sodium carbonate are recovered from burkeite obtained as a byproduct in the recovery of potassium chloride and borax from the brines in Searles Lake, Calif.

The process used by the Ozark Chemical Co. at its Monahans (Tex.) plant to recover and dehydrate sodium sulfate has been described by Douglass and Anderson.[21] Glauber's salt is dehydrated at this plant by "submerged combustion." A somewhat similar process of evaporation of hydrous sodium sulfate has been described by Schultz and Lavine.[22] Their process of "interphase evaporation" by hot combustion gases from burning peat was suggested for the commercial development of the natural sodium sulfate of North Dakota.

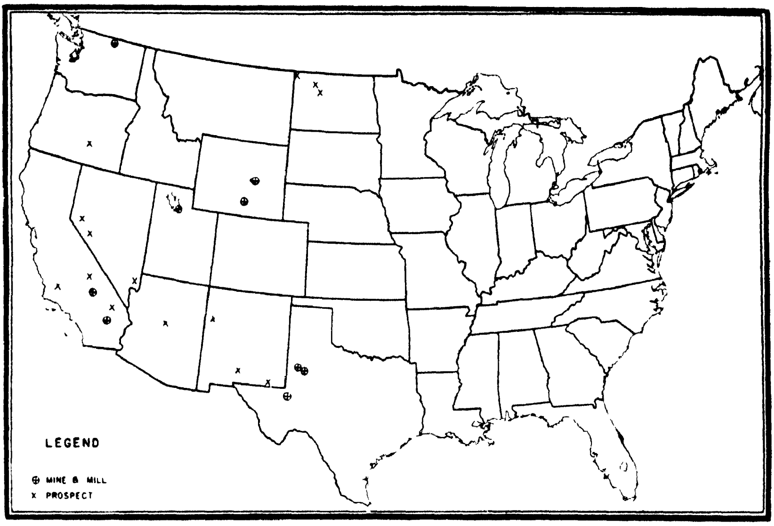

FIGURE 2.—Geographic distribution of sodium sulfate mines and prospects in the United States.

Several new sources of sodium sulfate have been discovered in New Mexico (see fig. 2). H. P. Powers of Gallup, N. Mex., reports discovery in that State of a large deposit containing over 80 percent sodium sulfate based upon the dry weight of the salts present. Minor constituents include magnesium sulfate and sodium chloride. The salts as recovered from the deposit contain some 45 percent moisture. The previously mentioned natural brines of southeastern New Mexico, described by Lang,[23] were also considered to be sources of sodium sulfate. It is suggested that sodium sulfate produced from this source could be sold to the nearby potash industry, to be used for converting sylvite into potassium sulfate and sodium chloride.

Prices of domestic salt cake in bulk were reduced to $13.00 per ton early in June 1941, despite the reduction in supplies brought about by the strike at the American Potash & Chemical Corporation. Prices, however, were increased to $15.00 per ton in September.

[21] Douglass, E. W., and Anderson, C. O., Submerged Combustion as Applied to Sodium Sulfate Production. Chem. and Met. Eng., vol. 48, No. 5, May 1941, pp. 135–137.
[22] Schultz, Robert F., and Lavine, Irvin, Interphase Evaporation of Sodium Sulfate Solutions: Ind. and Eng. Chem., ind. ed., vol. 34, No. 1, January 1942, pp. 59–64.
[23] Lang, Walter B., Article cited in footnote 11.

Sales of natural sodium carbonates, all produced in California, increased 13 percent from the 1940 total to 146,677 short tons during 1941. Estimated[24] production of sodium carbonate by chemical means during 1941 was 3,512,000 short tons of ammonia-soda process sodium carbonate and 18,000 short tons of electrolytic sodium carbonate, indicating an increase of almost 16 percent over the 1940 total for chemically manufactured soda. Virtually all major consuming industries required more soda ash to cope with higher operating schedules. New munition plants and increased requirements of the aluminum industry because of vastly expanded production and utilization of lower-grade ores, however, were direct factors resulting from the great defense effort of 1941. Reduced consumption of sodium carbonate in the manufacture of plate glass (owing to the ban on manufacture of private automobiles) is likely to be more than offset by substitution of glass for other less available materials and by increases in glass-container manufacture resulting from efforts to conserve the supplies of tin. It has been suggested that the use of soda ash in the desulfurization of steel be greatly increased to save manganese. This use of soda ash is widely practiced in Europe. Estimated possible consumption of soda ash in this application is of the order of 35,000 tons.

To meet the expanded requirements for sodium carbonate, emphasis was placed on recovery from natural sources by rapidly constructed and relatively simple temporary plants rather than on large and costly soda-ammonia process plants. Because some of the temporary plants would operate on submarginal deposits, they would require higher prices for their products; but they could be dismantled after the emergency with little loss, whereas the larger ammonia-soda plants might create a relatively large overcapacity for a considerable period.

Pike[25] suggested the establishment of a huge chemical industry in Wyoming based upon large deposits of trona discovered in 1939 about 20 miles west of Green River. It is proposed to sink a shaft to the deposits, which lie at a depth of 1,500 to 1,600 feet. The estimated cost of producing the trona by using room-and-pillar mining methods is $1.50 per ton.

Prices of sodium carbonates remained constant during 1941, but a slight revision was made in contract prices for 1942 to cover the cost of burlap packings. The light and extra-light soda ash in carlots, in bags, ranges from $1.05 to $1.13 per 100 pounds and the dense, in bags, $1.15 per 100 pounds, according to the Oil, Paint and Drug Reporter.

The American Potash & Chemical Corporation of Trona, Calif., is making additions to its plant for recovering soda ash from burkeite, a byproduct of the recovery of potassium chloride and borax from the brines of Searles Lake. The additions are expected to make possible an increased output of 40,000 tons of soda ash annually.

BORATES

Domestic production of borates during 1941 reached 301,282 short tons, a 24-percent increase over 1940, despite the 3½-month strike

[24] Chemical and Metallurgical Engineering, Commodity Reviews, Alkalis, and Chlorine: Vol. 49, No. 2, February 1942, pp. 84–86.

[25] Pike, Robert D., Possibilities for a Wyoming Chemical Industry; Statement before the Subcommittee of Public Lands Committee of the United States Senate, July 23, 1941; Chem. and Met. Eng. vol. 48, No. 9, September 1941, pp. 112–113.

at the plant of one of the leading producers and a sharp decline in exports. Apparent consumption of borates is estimated to have reached an all-time high, greatly exceeding the previous high of 211,739 tons attained in 1936. Increased industrial activity, substitution of ceramic and enameled ware for metals and alloys needed for war purposes, and military needs were largely responsible for the expanded consumption.

Salient statistics of the boron-mineral industry in the United States, 1937–41

	1937	1938	1939	1940	1941
Sold or used by producers: [1]					
Short tons	358, 898	215, 662	245, 284	243, 355	301, 282
Value	$7, 232, 897	$4, 739, 291	$5, 689, 797	$5, 643, 390	$8, 455, 422
Imports for consumption (refined): [2]					
Pounds	724	631	[3] 774	752	----------
Value	$176	$131	[3] $170	$185	----------
Exports:					
Short tons	154, 052	77, 519	91, 139	64, 313	[3] 28, 746
Value	$4, 715, 691	$2, 642, 446	$3, 230, 304	$2, 456, 523	[3] $1, 271, 509
Apparent consumption: [4]					
Short tons	204, 846	138, 143	154, 145	179, 042	([5])

[1] 1937: Borax, colemanite, kernite, and boric acid (calculated as borax); 1938: Borax, kernite, and boric acid; 1939: Borax, colemanite, kernite, ulexite, and boric acid; 1940–41: Borax, kernite, boric acid, and colemanite.
[2] Also 348 pounds of crude valued at $7 in 1939.
[3] Figures cover January to September, inclusive.
[4] Quantity sold or used by producers plus imports minus exports.
[5] Figures not available for publication.

Owing to the strike at Trona, Calif., mentioned heretofore, a temporary but acute shortage of borates developed, and it became necessary for the Office of Production Management to place borax and boric acid under full priority control from June 9 until August 30, 1941, to assure adequate supplies for military requirements. Settlement of the strike, however, soon restored conditions to normal, and continuance of priority control became unnecessary after August 30.

Producers held prices of borates constant during 1941, although resale prices often were much higher during the strike period. Upon the basis of increased manufacturing costs, a price advance was allowed on January 28, 1942, by the Office of Price Administration, which undertook to review and determine prices at the request of producers. This advance amounted to $1.00 a ton over the figure of $40.50 per ton of granular borax, bulk, carlots, and $2.00 per ton for boric acid, the technical grade of which sold at $93.50 per ton.

Research on the production and uses of boron compounds was active during 1941. Their use as fertilizers for soils deficient in boron continued to engage scientists, and some progress was reported in this field. Powers,[26] in summarizing the biological effects of boron, says—

Boron appears to give elasticity to the plant cell membranes and to aid cell division. It seems to regulate respiration, lessen effect of drought, has improved keeping qualities of apples and prunes, and prevents swelling and blocking of roots and pollen tubes. Boron prevents break-down of conduction tissues, is important in nitrogen metabolism, and aids development of nodules and nodule bacteria. Boron affects carbohydrate translocation and pectin formation and amount of calcium in tissues. Eaton (1940) reported boron to be essential to formation of auxin in plants, and Goldschmidt and Peters reported it essential in metabolism of brown algae. Boron is a constituent of animal tissues.

[26] Powers, W. L., Boron—A Minor Plant Nutrient of Major Importance: Better Crops with Plant Food, vol. 25, No. 6, 1941, pp. 9–11, 39–40.

The use of manganese or zinc borates together with chlorinated organic materials in fire-proofing compositions for textiles was begun during 1941. These borates, being fusible at low temperatures, cover the fibers on exposure to the flames. Thus, glowing and creeping of the fire are prevented; the chlorinated material alone could not do this. Zinc borate has the additional advantage of giving good resistance to mildew. A British patent [27] describes the use of boric acid esters as efficacious antioxidants for rubber and similar materials. Warth [28] reported tests indicating that borax has a rust-inhibitive action superior to that of any of the various alkaline reagents found in commerce and even to many so-called rust inhibitors. An Australian report indicated that boric acid was effective in the protection of timber against the powder post borers. Eight mills in Queensland and four in New South Wales are employing the new process, which has been in commercial use for approximately 2 years.

[27] U. S. Rubber Products, Inc., Preserving Rubber, etc.: British Patent 509,459, July 17, 1939

[28] Warth, A. H., Borax as a Rust Inhibitor: The Crown, vol. 30, No. 5, 1942, p. 20

GEM STONES

By Sydney H. Ball

SUMMARY OUTLINE

JEWELRY INDUSTRY IN 1941

Retail sales by jewelry stores in the United States totaled about $526,000,000 in 1941, a 30-percent increase over 1940 (when sales totaled about $405,000,000) and within 2 percent of those in 1929. An additional 18 to 24 percent was sold by department stores.

Arkansas, Connecticut, and Indiana showed notable advances over 1940 in retail sales. Again, as in 1940, gains were due mainly to larger turn-over of relatively inexpensive items, and sales of high-priced articles were the exception. This can be explained, in New York at least, by the colorless stock market.

The jewelry trade had two "Christmases"—the first late in September, when taxwise buyers bought heavily to avoid the 10-percent excise tax, and the real Christmas. During both periods the buying rate was higher than at any corresponding time since 1929. Some expensive articles were sold during both buying seasons, and certain of these, strangely enough, were purchased by European refugees. In 1941 the gain in sales may have been in part a hedge against inflation, that is, investment buying; but furthermore, compared with 1940 the Nation's income had risen from about $72,000,000,000 to about $92,000,000,000. Sales were also increased by an all-time record number of marriages (1,565,000), over 16 percent above those in 1940, which had been the banner year.

From year to year in the larger cities, a few of the better department stores are cutting into sales of retail jewelers, and it may be added that, on the average, they are handling stock of finer grade year after year.

Wholesale jewelry sales in 1941 were somewhat greater even than those of the retailers, and stocks in retail jewelry shops increased 14 percent. Manufacturers' personnel was employed full time. During the year, exports to South America, which normally obtains its jewelry supplies from Germany, were large.

The national income of Canada is also rising ($5,180,000,000 in 1940—$6,200,000,000 in 1941), and retail jewelry sales in 1941 topped those of 1940. Canadian prices have as their ceiling those of the basic

period September 15–October 11, 1941. Luckily, the more important shops had fairly extensive stocks when the price order went into effect; but as the war progresses, the transfer of machinery and artisans to war work and the lack of certain materials may cause a shortage of articles, resulting in smaller retail sales.

FASHIONS IN JEWELS

Large, flamboyant jewelry characterized the mode in 1941, a year in which it was used even with sport clothes. Gold continued to be worn more than platinum, although the latter was used in the finer diamond mountings. For the first time, however, industrial consumption of platinum exceeded that of the jewelry trade. Regimental and other military insignia and the "V for Victory" pins and clips were popular, but floral decorations, grotesque animals, geometric designs, and Victorian and South American motifs were also seen. Ensembles set with similar stones and large jewelry pieces divisible into several ornaments continued in favor. Clips and lapel pins were especially popular; watches, bracelets, earrings, and necklaces were less so. Double wedding rings are gaining popularity.

The shortage of melee is decreasing the use of pavé mountings, and more and more fine gems are being set "sec." Stones, such as citrine and aquamarine, weighing up to 400 carats (over 2 ounces), were used in bracelets and pins. Diamond (including some brown stones for men), sapphire (largely blue, but also yellow and pink), and ruby were the most popular gems, followed by topaz, moonstone, emerald, aquamarine, and amethyst. Due to the insistent demand for diamonds, colorless stones were dominant, followed by blue, red, yellow, and green. For the first time in many years, yellow stones were more popular than green and were used almost as commonly as blue and red stones. Owing to wider knowledge of gem stones in the United States, some 40 varieties were used in jewelry in 1941, in contrast to the few kinds once worn.

DOMESTIC PRODUCTION

From the 1909 peak output of gem stones valued at $534,280, domestic production dwindled to only $3,000 in 1934; but since that year productior has increased progressively and markedly and in 1941 was valued at $240,000 to $770,000. The first figure is a rough estimate of the value of uncut stones used in jewelry and the second an estimate of the total value after cutting, including stones added to mineralogists' collections or sold to tourists, collectors, and rock gardeners. Of the total value, 70 percent represents members of the quartz family, 18 percent sapphires (largely used industrially), and 12 percent turquoise. The principal producing States (in approximate order of output) were Oregon, Montana, Washington, Nevada, Wyoming, and Colorado.

The interest in beautiful minerals continues to grow; the number of professional and amateur lapidaries is increasing, particularly in Oregon (largely Portland and Newport) and Washington. Dr. H. C. Dake says that in those States the shops are operating at capacity and there is a shortage of skilled labor; cabochon-cut gems are being sold to American makers of costume jewelry; and agate balance knives and

mortars and pestles are being produced. Local machine shops manufacture cutting equipment, including diamond saws.

Professional gem cutters operate also in New York, Rhode Island (Providence), Maine, North Carolina, Montana, and South Dakota. Gem cutting is carried on as a hobby in many States, notably in Idaho, Wyoming, Utah, and North Carolina. Owners of precious-stone claims complain that amateur mineralogists "high-grade" the deposits in the absence of a resident watchman.

Agate and jasper are collected in quantity in Oregon and Washington, particularly on the beaches of Lincoln County, Oreg. Most of this is cut by local lapidaries, although some rough is shipped to other States. Montana continues to produce a considerable quantity of fine moss agate from the gravels of Yellowstone River in the southeastern part of the State. Wyoming also furnishes good material. Alfred M. Buranek states that Utah produced about $10,000 worth of agate in 1941. Arthur L. Crawford describes the principal varieties as jasper from the east bank of the Colorado River in Grand County; agate from 6 miles east of Cisco, Grand County; and red jasper geodes from Tidwell, Emery County. Arkansas produces considerable rock crystal from the vicinity of Hot Springs. Farmers dig most of it in the winter, but mineral dealers also mine some. Most of it is sold to tourists as curios, but some is used in jewelry. Scott's Rose Quartz Co. produced considerable rose quartz from its mine near Custer, S. Dak., and sold some for jewelry use.

In 1941, Montana produced about 3,720 troy pounds of sapphire (of which perhaps 50 percent was first-grade material), valued at some $43,000. The principal producers are American Gem Mines at Philipsburg, owned by Charles H. Carp and J. S. and R. M. Kaiser, and the Perry-Schroeder Mining Co., dredge operator of Helena. The former company operates on the West Fork of Rock Creek in Granite County, and the latter obtains its stones as a byproduct of gold-dredging Missouri River bars in Lewis and Clark County. Most of the stones are sold for industrial use; if for any reason the supply of synthetic sapphire should be inadequate to satisfy war demands for instrument jewels, Montana sapphire would have prime importance. Carl J. Trauerman (Butte Daily Post, June 3, 1941) believes that, if necessary, Montana could produce 150,000 to 200,000 ounces yearly. Besides the two localities mentioned above, production could be obtained from Brown's Gulch in Silver Bow County, Dry Cottonwood Creek in Powell County, and lode mines of Yogo Gulch.

Turquoise ranks after the quartz family and sapphire in value of production, with a total of about $28,000. Nevada ranks first in output and Colorado second. The principal producer in Nevada was the Smith mine at Cortez, operated by A. Guisti, which produced over 7,550 pounds; the material is shipped to E. C. Smith, Santa Barbara, Calif. The King mine at Manassa, Colo., had an unusually successful year, as one "pocket" alone produced almost 700 pounds of good material. Richard M. Pearl reports that W. S. Kettering of Pueblo opened up a deposit in Pueblo County, Colo., in 1941, some of the product being good gem material. Imitation turquoise is cutting somewhat into western turquoise sales.

Further data furnished by B. F. Couch, Reno, Nev., suggests that Nevada alone produced turquoise worth at least $20,000 in 1940, so that the author's estimate of $20,000 as the country's production in

1940 (Gem Stones, p. 1401, Minerals Yearbook, Review of 1940) is probably somewhat low. The chief production centers are Royston and southern Death Valley (Nye County), Battle Mountain, Cortez, and Austin (Lander County), and one deposit in Mineral County. Couch says also that in 1941 Nevada produced over 2,175 pounds of good material worth $13,775, with two producers not reporting. The Smith mine in the Bullion district, Lander County, was the chief producer, followed by mines in northern Lander County and the Royston and Beatty districts, both in Nye County.

Richard M. Pearl (see Bibliography) states that Colorado has for several years ranked second among the States as a turquoise producer, the gem stone occurring at four localities in the southwestern part of the State. The principal mines are the Hall near Villagrove and the King near Manassa; both of these deposits occur in felsite porphyry. The deposit near Leadville occurs in Silver Plume (Algonkian) granite, and turquoise near Creede occurs as stream pebbles. The turquoise of the lode deposits is believed to have been deposited by cold meteoric waters in fractures and shear zones.

Alfred M. Buranek states that about $2,000 worth of variscite was produced from the Clay Canyon deposit near Fairview, Utah. Jewelers, museums, and mineral collectors were the purchasers.

Vergil E. Barnes (North American Tektites, University of Texas Publication 3945, Austin, June 1940, pp. 477–582) describes the only tektites yet found in North America. The first of these, which have been dubbed "bediastites," was found in Grimes County in 1936, and in all 482 have been recovered. To the local residents they are known as "black diamonds," and some have been cut for jewelry. They are found in an area 10 miles long and 5 miles wide. The tektites are black and have an average specific gravity of 2.37; the largest weighed 59.4 grams. Most of them are ellipsoidal, and a few are spherical or tabular with their exterior deeply furrowed. The tektites consist dominantly of silica (73.52 to 77.76 percent) and alumina (13.3 to 15.88 percent), with low lime. Barnes considers them fulgurites.

Several hundred carats of colorless and yellowish topaz was obtained from the Tarryall Mountains, Park County, Colo. Gems up to 5 carats in weight have been cut from this material (according to a letter from R. M. Pearl). Topaz Mountain in the Thomas Range, Juab County, Utah, also produced a little topaz. Dr. H. C. Dake reports that some nephrite of gem quality was obtained from the two Wyoming localities (Fremont County and 48 miles southwest of Lander); at the first locality the material is mined from a dike, and at the second it occurs as boulders. One mass weighed 119 pounds. He states that in 1941 about 1 ton of this variety of jade was produced, the best rough material selling for $5 a pound. Alfred M. Buranek states that a little fine pyrope garnet was mined near Mexican Hat in southeastern Utah. Some was sold to prominent jewelers. Only three or four Indians worked the catlinite deposit at Pipestone, Minn., in 1941.

Other gem stones produced in the United States in 1941 included agate (Arizona, Colorado, Georgia, Montana, Oregon, South Dakota, and Utah); agatized wood (Arizona (private lands surrounding Petrified Forest National Monument) and Wyoming); alabaster (South Dakota); amazonstone (central Colorado); amethyst (Colorado, Georgia, South Carolina, LaSal Mountains and San Rafael Swell in

Utah, and near Liberty, Wash.); apatite (South Dakota); aquamarine (Colorado, Georgia, North Carolina, South Dakota, and Wyoming); azurite (northern Colorado); carnelian (Bastrop and Colorado Counties, Tex.); chalcedony (Colorado); chrysoprase (North Carolina); emerald matrix (North Carolina); epidote (Milford, Utah); garnet (Georgia; rhodolite from Mason County, N. C.; and a variety from the Oregon coast known locally as "Oregon jade"); hematite (Platte County, Wyo.); jasper (Socorro County, N. Mex.); jet (Mesa County, Colo.); lapis lazuli (Gunnison County, Colo.); opal (Georgia and Wyoming); moonstone (North Carolina); opalized wood (central Washington); rhodonite (North Carolina); rock crystal (Colorado, Georgia, and Idaho); rose quartz (Maine and North Carolina); rutilated quartz (North Carolina); smoky quartz (Colorado, North Carolina, and Utah); sapphire and pink sapphire (Macon County, N. C.); and tourmaline (Milford, Utah).

A little pale emerald occurs in the beryl-bearing pegmatites northeast of Winnipeg, Manitoba, Canada.

IMPORTS

On January 2, 1942, the United States Department of Commerce announced that "in the interest of national and hemisphere war effort, no further detailed statistics concerning the foreign trade of the United States" would be published. Imports of precious and imitation stones (exclusive of industrial diamonds) into the United States for the first 9 months of 1941 totaled $22,802,940, a 19-percent decrease compared with the corresponding period of 1940. Details for 1941 are shown in the following table.

Precious and semiprecious stones (exclusive of industrial diamonds) imported for consumption in the United States in 1941 (January–September, inclusive) [1]

	Carats	Value
Diamonds:		
Rough or uncut (suitable for cutting into gem stones), duty free	124, 202	$5, 967, 938
Cut but unset, suitable for jewelry, dutiable	182, 652	13, 570, 481
Emeralds:		
Rough or uncut, free		
Cut but not set, dutiable	18, 497	247, 730
Pearls and parts, not strung or set, dutiable:		
Natural		145, 897
Cultured or cultivated		423, 918
Other precious and semiprecious stones:		
Rough or uncut, free		75, 111
Cut but not set, dutiable		2, 074, 363
Imitation, except opaque, dutiable:		
Not cut or faceted		9, 703
Cut or faceted:		
Synthetic		217, 988
Other		18, 806
Imitation, opaque, including imitation pearls, dutiable		26, 957
Marcasites, dutiable:		
Real [1]		22, 208
Imitation		1, 840
		22, 802, 940

[1] Figures for 1940 in Minerals Yearbook, Review of 1940, p. 1403, should read—Marcasites, real, $8,220; grand total, $37,769,135.

Imports of pearls and cut precious stones and imitation stones increased notably, while all other subdivisions decreased. Imports of uncut diamonds decreased sharply, suggesting that American cutters overbought in 1940. The decrease in cut imported was somewhat less drastic. The number of watch jewels imported in the first 9 months of 1941 totaled 79,875,751 valued at $1,769,689, compared with 98,771,042 valued at $1,831,007 in the 12 months of 1940.

Synthetic rubies and sapphires imported in the first 9 months of 1941 totaled 440,491 pieces worth $217,988, or 71.8 percent of the quantity and 75.3 percent of the value imported in the corresponding period of 1940. Imports of synthetics were small in the third quarter of 1941 and are believed to have been negligible in the fourth quarter.

GOVERNMENT REGULATIONS

Again, due to the war, Government regulations covering the jewelry trade were legion in 1941. Great Britain, Germany, Italy, and France made strong efforts to divert funds normally spent on jewelry to Government securities.

EFFECT OF WAR ON SOURCES OF GEMS

The prices of colored stones, like those for diamonds, have increased since the Second World War started. For instance, fine rubies and emeralds are 15 to 20 percent higher and some of the less noble gems and all synthetics even more.

War in the Pacific has removed Thailand and Indochina from the list of countries from which the United States obtains precious stones. The principal sources of zircons (rough, Indochina; cut in Thailand) therefore can no longer trade with us. Thailand also supplied a few sapphires and rubies. Japan provided most of our cultured pearls. Furthermore, as a result of the war, imports of gems from India will have to be rerouted, and receipt of precious stones from Burma may be temporarily interrupted.

With the declaration of war imports from Germany (largely imitation stones) and Italy ceased, and the difficulty of importing watches and watch parts—notably jewels—from Switzerland increased.

Bombay (Bureau of Mines Mineral Trade Notes, August 20, 1941, pp. 27–30) has long been one of the more important precious stone markets of the world. However, before the war started, Bombay had virtually no direct trade with the United States; its stones were exported to London or Paris—then the center of the trade in colored stones—where American gem merchants purchased their requirements. Bombay does not control the output of any important gem-stone deposits but has always been only a junction point in the world circulation of precious stones. However, conditions have changed since the war. In 1938 Bombay exported $35,169 worth of gem stones and pearls; in 1940, $443,020. The increase of its exports to the United States has been even more remarkable, because American importers now look to Bombay instead of Paris for their colored stones. The quantity of stones exported is controlled by the Reserve Bank of India. Rubies from Mogak, Burma, are the principal exports. Although star rubies are cut in Burma, other Burmese rubies are cut largely in Cambay, India, and a few in Bombay itself. The price of

rough rubies has increased 15 to 20 percent since the war began, although the price of cut stones has changed little. Star rubies and sapphires sell for four or five times their pre-war price. Sapphires are imported from Burma, Ceylon, and Kashmir and emeralds from Ceylon and U. S. S. R.; diamonds, formerly imported from Europe, usually are sold locally. Since March 1940, an export certificate, obtained at an accredited bank, is required before gems can be exported to the "hard-currency" countries. Precious stones cannot be imported from "hard-currency" countries. An ad valorem duty of 5 percent is paid on most stones imported, although gems from Burma are exempt from duty.

China is sending us tiger-eye and quartz cameos, which formerly were purchased in Germany.

Although there seems to be no deficiency in the supply of fine rubies, sapphires, and emeralds, there is a distinct shortage of the less expensive grades of these gems, of some of the lesser gems, and of synthetics. Brazil, however, is supplying the United States with sufficient aquamarine, topaz, citrine, amethyst, and tourmaline, and our imports (both cut and rough) from that country are increasing. In view of the unusually good demand for colored stones, the lack of adequate cutting facilities in the United States is unfortunate. American lapidaries are working overtime cutting South American rough and recutting into modern shapes stones recovered from old jewelry. Some South American chalcedony is being stained into black onyx

DIAMOND

A layman would have expected the diamond industry, which produces a luxury, to be one of the first adversely affected by the war. In reality, in 1941 it enjoyed relative prosperity, notwithstanding the fact that its processing branch—the cutting of gem stones—is about one-eighth as large as normally since the invasion of the Low Countries.

Production was appreciably smaller than in 1940 and, indeed, less than in any year since 1937. Sales of rough, on the other hand, were large, due partly to a slight increase in sales of gem stones in America but largely to huge sales of industrials. Prices of rough and fine large cut advanced; prices of small cut held at two to four times those of early 1940. "Investment" buying increased in 1941—in Europe in "black markets," in the United States in a free market.

Share dealings.—The shares of diamond-mining companies, virtually all of which are listed on the London Stock Exchange, gained over 75 percent during the year and in the fall were market leaders. Until Russia showed its strength, the market was uninteresting, but by mid-September a gain of 50 percent had been made. Prices sagged in October, rose sharply in November, weakened on the entrance of the United States (the chief market for cut) into the war, and at the year end strengthened on good dividend declarations. The market rise was in contradistinction to a 14-percent rise in English industrials and a loss of 18 percent during 1941 on the New York Stock Exchange. At the year end, diamond-mining stocks were 39 percent of their high (1927) and 445 percent of their low (1932). Of the 12 leading diamond-mining companies, 11 paid dividends; the twelfth, Cape Coast Exploration, is soon to make a handsome liquidation payment.

Market.—In 1941, the Diamond Trading Co., which in normal times controls the sale of about 95 percent of world production, sold

rough valued at about £7,500,000 (£6,144,314 in 1940). The United States bought such "American qualities" (fine, relatively large stones) as were available and some fine small rough, but the increase in sales was due principally to large purchases of industrial diamonds by the Governments of the United States and Russia and by American brokers. In addition to its London and Kimberley offices, the Diamond Trading Co. in the fall opened an office at Hamilton, Bermuda, to deal with cutters and brokers residing in the United States.

In 1941 the American market for cut was featured by an increasing demand, a reasonable supply of large cut, and a wholly inadequate supply of small cut. There was a fair turn-over in polished stones in Great Britain, notwithstanding Government attempts to restrict it. The finer stones were sold for "investment" purposes in a thriving "black market." South America, Canada, and India were relatively large buyers of cut. Citizens of Nazi-occupied Europe desired to "invest" in diamonds, but opportunities were few.

Prices of rough diamonds advanced 10 to 15 percent, and a further rise is likely early in 1942. Prices of fine, large cut are 10 to 20 percent higher than in pre-war days, and prices of small cut have doubled or quadrupled. In America, a fine 1-carat stone costs what it did before the 1929 crash; in Nazi-occupied lands and in the British "black market," prices are much higher.

Stocks of rough increased somewhat in 1941 but will decrease in 1942. Those in the hands of American cutters are adequate, as are those of fine, large cut; however, the supply of small cut is pitifully low.

Imports.—On September 30, 1941, the Department of Commerce ceased to publish import figures. Imports from January 1 to September 30, 1941, were as follows:

Diamonds imported into the United States in 1941 (January–September, inclusive), by countries

[Exclusive of industrial diamonds]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
Argentina				146	$8,607	$58 95
Belgium				123,052	6,722,113	54 63
Brazil	35,825	$1,261,715	$35 22	2,470	276,702	112 03
British Malaya				73	6,872	94 14
Cuba				191	16,947	88 73
France				3,867	474,752	122 77
Germany				539	42,337	78.55
Mexico				432	35,314	81.75
Netherlands				1,123	42,384	37 74
Netherlands Indies				104	5,339	51 34
Palestine				3,409	398,123	116 79
Switzerland				630	108,796	172 69
Union of South Africa	88,377	4,706,223	53 25	31,043	3,776,182	121 64
U S S R				30	2,250	75 00
United Kingdom				15,543	1,653,763	106 40
	124,202	5,967,938	48 05	182,652	13,570,481	74 30

Cutting.—In May 1940 the world cutting industry was completely disorganized, having lost 90 percent of its operatives as a result of German invasion of the Low Countries. A few cutters escaped and

reestablished their trade in far corners of the earth, others were marooned in France, but most were caught in the Low Countries. The United States and South Africa and, to a smaller extent, Great Britain and Palestine furnish an adequate supply of "American qualities" (fine, large cut), but there is a woeful shortage of small cut. Germany has attempted without success to reestablish the industry in Belgium and the Netherlands.

By a fluke, New York is now the leading diamond-cutting center of the world, with some 650 cutters and a large number of apprentices. Several firms are attempting to cut melee. Some of the more experienced cutters make over $235 a week. South Africa has 300 to 400 cutters, Great Britain 200 to 250, Palestine perhaps 200, Puerto Rico 75, and Java a few. Borneo and Brazil cut some diamonds for the local trade, but their product is not cut well enough for the American market.

World production.—For the second year, due to the war, actual diamond-production figures are not available, but the estimates in the following table are believed to be fairly accurate. World production (gems and industrials) in 1941 is estimated to have been 9,088,000 carats (1.817 metric tons) valued at about $27,000,000. Compared with 1940, the total weight decreased 36 percent and the value 19 percent. The average quality of the stones produced was better than in 1940, bort representing perhaps 78 percent of the caratage and gem stones 22 percent. Belgian Congo was the leading world producer, both in weight (over 67 percent of the total) and in value (27 percent). The British Empire produced 19 percent of the total by weight and 31 percent by value. The South African pipe mines were not operated; consequently, all production was from alluvial mines.

The following table shows, as accurately as available statistics permit, world production for the past 5 years.

World production of diamonds, 1937–41, by countries, in metric carats

[Including industrial diamonds]

Country	1937	1938	1939	1940	1941
Africa:					
Angola	626,424	651,265	690,353	784,270	787,000
Belgian Congo	4,925,228	7,205,620	8,344,765	[1] 10,900,000	6,106,000
French Equatorial Africa	5,588	16,013	[1] 16,000	[1] 16,000	20,000
French West Africa	54,687	61,928	56,314	[1] 75,000	35,000
Gold Coast (exports)	1,577,661	1,296,763	1,087,652	[1] 825,000	743,000
Sierra Leone	913,401	689,621	[1] 600,000	750,000	850,000
South-West Africa	196,803	154,856	35,470	30,017	46,614
Tanganyika (exports)	3,234	3,576	3,445	2,250	[1] 1,750
Union of South Africa:					
Mines	820,284	979,460	1,089,144	[1] 351,447	
Alluvial	207,359	259,147	160,684	[1] 172,027	112,300
Total Union of South Africa	[2] 1,030,434	1,238,607	1,249,828	[1] 523,474	112,300
Brazil	238,606	235,000	[1] 350,000	[1] 325,000	325,000
British Guiana	35,958	32,522	32,491	[1] 26,764	27,000
Other countries [3]	6,000	34,200	19,000	31,750	34,350
Grand total	9,614,024	11,619,971	12,485,318	[1] 14,289,525	9,088,014

[1] Estimated

[2] Includes small quantity of diamonds derived from re-treatment of tailings.

[3] 1937: Includes Netherlands Indies (Borneo), India, Australia (New South Wales), Liberia, Venezuela, and Rhodesia. 1938: U. S. S. R., India, Borneo, New South Wales, and Venezuela; 1939: Venezuela, India, Borneo, New South Wales, and U. S. S. R.; 1940 and 1941: Borneo, India, New South Wales, U. S. S. R., and Venezuela.

Most countries showed decreased production as compared with 1940, although Sierra Leone and South-West Africa made minor increases.

During the year, DeBeers Consolidated Mines, Ltd., absorbed Cape Coast Exploration, Ltd., and now owns or controls all important diamond mines in the Union of South Africa and South-West Africa except the State mines of Namaqualand.

In 1942 some of the companies are to attempt to increase production of the industrial stones so necessary today and may succeed. If the war continues, however, the long-term outlook is for a drying up of production as certain essential supplies will be lacking owing to the isolated position of the mines now producing.

Industrial diamonds.—The use of industrial diamonds continues to increase amazingly. The expansion, of course, is due largely to the national defense and war programs, but even without a war the increase would have been marked. World consumption in 1942 is expected to approach 7,500,000 carats, or more than the world production of industrial grades. For several years, stocks of certain types of fine industrial diamonds have been small; however, users will find that the grades substituted are satisfactory.

With signing of the United States-Brazil Trade Agreement (May 15, 1941), the Axis Powers lost their last primary source of industrial diamonds. It is reported that Germany is now using gem stones industrially.

On March 18, 1941, industrial diamonds were classified among the critical war materials, and after April 15 they could not be exported from the United States without an affidavit, except to the British Empire. Since October 31, 1941, American dealers and users have had to report quarterly stocks on hand and transactions completed. The United States Government began to stock-pile diamonds in June 1940.

The percentages, by value, of the chief uses for industrial diamonds follow:

	Percent
Diamond drilling	45–40
Diamond-set tools	30–35
Diamond dies	10– 7
Crushing bort (bonded wheels and tools)	10– 7
Miscellaneous	5–11

In 1940, for the first time in 3 years, diamond drilling in Canada by contractors increased (1939: 391 miles; 1940: 459 miles). The use of diamond drills in stope blast-hole drilling also increased in Canada, and it is reported in the copper mines of Rhodesia and Belgian Congo. The use of diamond-impregnated bits in drilling is increasing.

The demand for diamond dies is large. Formerly the specialty of France, they are now being produced in America, and mechanical methods successfully replace meticulous hand methods.

The Diamond Trading Co. announced that it would not raise the price of industrial stones during the war Indeed, the price of Congo (Beceka) crushing bort was reduced in the summer of 1941. Whether the price differential between this grade and those of South Africa and Gold Coast is warranted seems questionable.

Imports of industrial diamonds into the United States during the past 5 years were as follows:

Industrial diamonds (glaziers', engravers', and miners') imported into the United States, 1937–41

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1937	1,885,970	$6,542,365	$3.47	1940	3,809,071	$11,026,563	$2.89
1938	1,396,247	4,213,412	3.02	1941 (Jan.–Sept.)	2,911,117	7,415,133	2.55
1939	3,568,730	9,725,683	2.73				

RUBY, SAPPHIRE, AND EMERALD

Production of precious stones in Burma seems fairly well stabilized. The 1939 production was 211,570 carats of rubies and 10,532 carats of sapphires. A few spinels and other gem stones are byproducts.

Sapphires continued to be produced in 1941 in the Anakie field, Central Queensland. Prices reached perhaps an all-time peak; £85 an ounce was refused for high-quality gems, blue stones brought £45 an ounce, and second-grade stones realized 15 to 30s. an ounce.

Ceylon is changing its mining laws. The Revenue Office now determines gem-mining royalties, the land (both Crown land and that alienated by the Crown) to be exploited, and the location of the workings. Natives are to be trained, after the European method, to cut gems for beauty and not for weight. As Ceylon is a tourist center from which every globetrotter desires to bring a precious stone, prices are higher on the average than they are in Europe. A fine star ruby weighing 310 carats was found in Ceylon by Dr. D. P. E. de Silva late in 1941. Some 15 years ago one weighing 215 carats was found and sold for Rs. 85,000.

LESSER GEMS

Australia is the world's principal source of opals, and its output from 1936 to 1939 ranged in value from $40,000 to $75,000 a year. Since 1936 South Australia (1938, £4,750; 1939, £6,020) has been the principal producer, followed by New South Wales. Queensland's production is small (1938, £80; 1939, £50). In 1941 the fields were reported to be doing well and the diggers busy. The market for opals was said to be good.

The ancient turquoise mines of Madan are about 30 miles west of Nishapur, Iran (Bureau of Mines Mineral Trade Notes, January 20, 1942, pp. 26–28). The Iranian Government farms out the mines to operators for about $2,000 a year. When India, the principal market, is buying in quantity 150 men are employed; at present the demand is poor, and only 20 men are employed. As for most gem mines other than those producing diamonds, profits are small. Turquoise occurs as seams and nodules in brecciated trachyte porphyry. Mining consists of open pits, shafts, and tunnels. To minimize shattering, powder is used instead of dynamite. If the color of the gem does not change within 2 weeks of mining, it is likely to be relatively stable.

The stones are cut at Meshed, 75 miles from the mines. The Iranian market absorbs 10 percent of the product; of the remainder, the best goes to India, and the poorer qualities go to Mecca for the pilgrim

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trade. From June 21, 1936, to March 20, 1940, yearly exports have averaged about 822 kilos of cut and 825 kilos of uncut, worth, respectively, 884 rials and 19 rials per kilo (at 50 rials to the dollar, $17.68 and $0.38, respectively.)

Brazil produces a number of gem stones, notably aquamarine, pale emerald, tourmaline, amethyst, yellow and blue topaz, and citrine. The value of aquamarine exported is normally 10 times that of tourmaline. Exports are considerably larger than the declared value, recently estimated as $10,000. Minas Gerais is the principal producer. The war apparently reduced 1941 exports somewhat.

Chile exports considerable tonnages of green "onyx" to the United States through the port of Antofagasta.

Despite Government restrictions, zircon continued for a time to pass the Indochinese border into Thailand for cutting at Bangkok. As already stated, upon the outbreak of the war in the Pacific, Thailand ceased to be a source of zircon for the United States.

South-West Africa, normally a large producer of aquamarine, tourmaline, and other lesser gems, produced 4,075.031 kilos of gems in 1939. As Germany had been the chief buyer, trade languished after the war started.

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MINOR NONMETALS

By Paul M. Tyler and Charles L. Harness [1]

SUMMARY OUTLINE

GRAPHITE

Demand for almost every quality of graphite rose sharply in 1941 in response to expanded industrial activity and soaring requirements of munitions industries. The increase in tonnage was greatest in respect to Mexican amorphous, but percentagewise the demand for crucible grades was greatest. Stocks of Madagascar flake graphite were only moderate at the beginning of the year, and procurement of additional supplies was complicated by the fact that the island was Vichy-controlled. Under British and American Government auspices, certain quantities of Madagascar flake graphite were loaded and shipped to the United States; but further increases in the demand for crucibles from shipyards and other establishments producing matériel threatened to force the crucible industry to substitute Ceylon plumbago, even though this would have involved going back to World War I practice and manufacturing crucibles that would last only about half as many heats as modern crucibles made with Madagascar flake. After Pearl Harbor, the Far Eastern situation worsened steadily, so that it seemed doubtful whether even Ceylon plumbago would be available in quantities adequate for British and American needs. On February 17, 1942, the War Production Board issued Order M-61 restricting the use of plus-35-mesh Madagascar flake graphite to the manufacture of crucibles for the war effort only and naming the Metals Reserve Co. as sole importer of graphite of this quality. The order permits use of fines in ladle stoppers.

Meanwhile domestic mining possibilities were actively investigated. The Southern Experiment Station of the Bureau of Mines, Tuscaloosa, Ala., obtained samples from abandoned mines in Alabama in cooperation with the State University. In tests of samples of the crude graphite by improved methods of beneficiation, the Bureau investigators found a wide variation in quality but succeeded in producing a medium-coarse flake product containing 85 percent or more carbon

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

with good recoveries. From a group of 22 samples, said to represent a fairly complete cross section of the district, an average yield of 33 pounds of coarse flake was obtained per ton of raw material. Samples from certain mines indicated a yield of about 30 pounds per ton of small-size flake, which would have industrial uses. Tests of these concentrates by crucible manufacturers indicated that Alabama graphite could be used, although it was not a wholly satisfactory substitute for Madagascar flake, owing to the absence of coarser screen sizes. The following comparison was given by Clemmer and associates:[2]

Screen analyses of Madagascar and Domestic No. 1 flake graphite

Mesh range	Weight, percent		
	Madagascar samples		Domestic sample
	A	B	
Plus-20	7.8	11.5	4.6
Minus-20, plus-35	65.7	59.4	17.9
Minus-35, plus-65	24.9	24.9	62.5
Minus-65	1.6	4.2	15.0
	100.0	100.0	100.0

Further experimentation subsequently was directed toward avoiding destruction of coarse flake in grinding, and preparations were made early in 1942 to foster new commercial production with the aid of Government financing. Geological investigations indicated the possibility of getting crucible-grade flake from Pennsylvania, and early in 1942 old mining areas in the Chester (Pa.) district were being prospected. Plans were also made to resume the production of small-flake graphite in Texas. During 1941, however, except for small shipments from the Ceylon Graphite Co. operations near Good Water, Coosa County, Ala., virtually all the domestic output of crystalline graphite was furnished by the St. Lawrence Graphite Co., which took over the properties of the Long Valley Ore Co. in St. Lawrence County, N. Y. Minor quantities were shipped from stock at Dillon, Mont.; Elberton and Royston, Ga.; and Omak, Wash.

As in former years, amorphous graphite for paint was mined by the Carson Black Lead Co. in Nevada, and artificial graphite was manufactured and sold by the Acheson Graphite Co. (30 East 42d Street, New York, N. Y.) at Niagara Falls and by the Exolon Co. at Blasdell, N. Y. Early in the summer of 1941 the low-grade anthracite-graphite deposits of the Graphite Mines Co. at Cranston (Providence), R. I., were being reopened after several years idleness. This material is used principally in foundry facings. In Canada the Black Donald Graphite Co., Calobogie, Renfrew County, Ont., continued to keep its mill running on material dumped during earlier operations. The mine seems to have been virtually worked out. Until recently much of this graphite, which is a very small flake, had been sold to American pencil-lead manufacturers; but in 1941 exports were prohibited, and the Canadian Government was investigating ways to revive graphite

[2] Clemmer, J. Bruce, Smith, R. W., Clemmons, B. H., and Stacy, R. H., Flotation of Weathered Alabama Graphitic Schist for Crucible Flake. Geol. Survey Alabama Bull. 49, 1941, 101 pp.

mining in the Dominion. Graphite claims at Sagalen Bay, Labrador, were said[3] to have commercial possibilities.

Notwithstanding the growing shortage of Madagascar and Ceylon graphite, prices were held down by suppliers. Typical quotations for carload shipments ex-dock, New York City, duty paid, in 1941 (1940 figures in parentheses) were as follows: Madagascar flake, 8 to 9½ cents per pound (6½ to 8 cents); Ceylon lump, 8 to 17 cents (7 to 15 cents); chip, 7 to 12 cents (5 to 10 cents); and dust, 3½ to 8 cents (3½ to 8 cents).

Ocean freight on Madagascar flake, which before the war was about $11 a ton, advanced in 1941 to as much as $40. The 1941 prices for Ceylon lump were only one-fourth to one-half what they were in the World War of 1914–18, when they ranged from 28 to 32 cents a pound.

During the first 9 months of 1941 imports of all grades of graphite totaled 20,051 short tons valued at $1,297,402. Figures for 1941 cannot be published by grade or by country of origin. Data for the entire year 1940 were: Flake, 6,551 tons valued at $340,396; lump, chip, and dust, 752 tons, $54,027; natural amorphous, 23,766 tons, $487,675; and total, 31,069 tons, $882,098.

Information on world production of graphite has been meager since 1938, when the output was over 140,000 metric tons. The following production data are for 1940: Madagascar, 15,311 metric tons; Ceylon, 24,414 tons; and Mexico, 12,327 tons. Mexican production in 1941 was 16,928 tons. A table covering the period 1915–39 appeared in Minerals Yearbook, Review of 1940, p. 1414.

GREENSAND

Shipments of greensand by four companies in New Jersey reached 11,120 short tons valued at $619,664 in 1941, compared with 6,697 tons, $389,888 (revised figure), in 1940 and 6,466 tons, $318,550 (revised figure), in 1939. In earlier years, the value recorded for greensand by the Bureau of Mines was that of the refined greensand produced. For 1941, the value is that of the product as sold—refined or processed further—and the values for 1940 and 1939 have been revised to this basis. Whereas refined greensand is available at $16 to $25 a short ton f. o. b. works, a large part of the output is processed further by the same companies that mine the raw sand and is sold as a water softener at prices up to $115 a ton. Although New Jersey greensands contain a small quantity of potash and phosphorus, very little is used as a fertilizer, the output being consumed almost entirely in water-softening compounds.

KYANITE, ANDALUSITE, AND DUMORTIERITE

Consumption of the sillimanite-group minerals increased sharply in 1941. Shipments of domestic kyanite by five firms rose to 8,335 short tons valued at $175,581, topping the previous all-time record (4,241 tons valued at $93,716) made in 1940. Notwithstanding the shortage of shipping space, imports of British Indian kyanite also increased in 1941; receipts during the first 9 months (the period for which figures can be published) amounted to 6,211 short tons having a foreign market value of $81,356, compared with the previous record of 7,658 tons valued at $92,159 in the full year 1940.

[3] Bureau of Foreign and Domestic Commerce, Foreign Commerce Weekly: Vol 5, No. 1, October 11, 1941, p. 31.

Andalusite is mined on White Mountain, Mono County, Calif., by Champion Sillimanite, Inc., Merced. The same firm—only domestic producer of either mineral in 1941—also ships dumortierite from its mine at Oreana, Pershing County, Nev., to the parent firm—Champion Spark Plug Co., Detroit, Mich.—which uses both materials in spark-plug cores and other electrical porcelains.

Celo Mines, pioneer producer of kyanite at Burnsville, N. C., suspended operations temporarily in 1941 but reopened later in the year as Mas-Celo Mines, Inc., subsidiary of Munn & Steel, Inc., 130 Lister Avenue, Newark, N. J.

One of the largest kyanite deposits in the United States is on Baker Mountain in Prince Edward County, Va., near Pamplin and about 20 miles from Farmville. As stated in several recent publica-

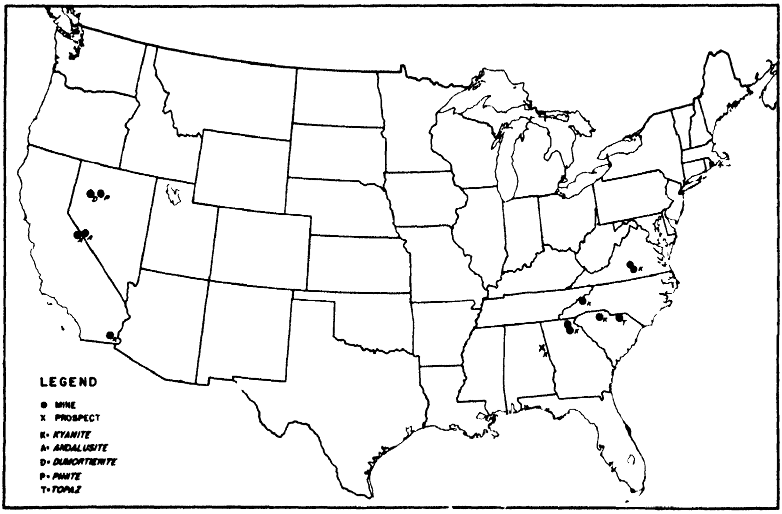

FIGURE 1.—Occurrence of minerals of the sillimanite group in the United States.

tions,[4] the kyanite occurs there in a quartzite schist as abundant massive kyanite-quartzite bodies with impurities such as rutile, hematite, pyrite, and quartz. To remove the impurities the quarried product is ground to at least 35-mesh and processed by flotation and magnetic separation, yielding a 93-percent kyanite concentrate which may be washed in acid to give an even purer product (0.32 percent Fe_2O_3).

A digest follows of a report by R. B. Heuer, chairman of the Nonmetals Group of the National Academy of Sciences Advisory Committee on Metals and Minerals, to the Office of Production Management in late 1941:

> The metallurgical industries account for about 50 percent of the total kyanite refractories used in the United States. Kyanite or other superrefractories (alumina, spinel, fused aluminosilicate, chrome, etc.) are not really needed in brass melting except for high-melting alloys, less than 25 percent of the total

[4] Hubbell, A. H., Preparing Baker Mountain Kyanite for Market: Eng. and Min. Jour., vol. 142, No. 10, October 1941, pp. 53-55.
Sawyer, J. P., and Whittemore, J. W., The Development of a Refractory Aggregate from Virginia Kyanite: Bull. Virginia Polytech. Inst., Eng. Exp. Sta. Ser. 49, November 1941, pp. 5-36.
Anderson, C. E., Electricity Furnishes Power for Kyanite Production in Virginia: Southern Power and Industry, vol. 58, No. 10, 1940, pp. 76-79; Ceram. Abs., vol. 20, No. 6, June 1941, p. 145.

tonnage. In ferrous melting, high-alumina refractories, which cost only one-fifth as much as kyanite products, are equally serviceable when temperatures are not too high, but above 3,000° F. the latter have twice the life. In smaller furnaces, fused alumina and magnesia linings have life equal to kyanite. Kyanite roofs in small, direct-arc, electric furnaces (1,000 pounds or less) will last longer than silica, even under continuous operation, and afford at least five times the life in intermittent operation. In the glass industry kyanite, due to its refractoriness, high density, resistance to corrosion, and low spalling, is in a class by itself in respect to feeders, plungers, and intricate shapes and is economical to use in the superstructure or bottom at various critical points. The chief ceramic use is in high-temperature kiln furniture for open-type firing in tunnel kilns. For laboratory test kilns for intermittent, extremely high temperature service, especially under load, kyanite has no general substitute, although fused cast products of mullite or high alumina have been used successfully on a limited scale. There are many miscellaneous minor refractory uses for kyanite which in the aggregate account for only 5 percent of the consumption. Many of these are intricate shapes that can be made from kyanite because the volume change in burning is negligible. Fire-clay products shrink on firing, and volume-stable products made from alumina or fused magnesia spall too much.

Shipping rates on kyanite from Calcutta increased from $11.20 to $16.80 a short ton during 1941, and the cost of Indian kyanite delivered at Atlantic seaports rose from about $25 to over $30 a short ton. Prices for domestic kyanite in 1941 ranged from $3 a short ton, works, for crudes to around $78 a ton f. o. b. plant for high-grade, low-iron domestic material ground to 325-mesh. Andalusite and dumortierite, virtually unknown on the open market, were arbitrarily valued at $10 to $15 a ton at the mine.

LITHIUM MINERALS

Shipments of lithium minerals and compounds reached 3,832 short tons valued at $115,718, a record for recent years, compared with 2,011 tons and $80,679 in 1940 (revised figures). Shortly before the World War of 1914–18, output was about 500 tons annually, with an average value of $20 a short ton at works. The largest production ever recorded was in 1920, when the total jumped to 11,696 tons valued at $173,002 owing to a sudden demand for lepidolite from California and New Mexico mines, but immediately thereafter production declined sharply and subsequently averaged less than 2,000 tons annually.

The quantity of lithium compounds required for the war program was not large in 1941 but may increase greatly. Hitherto the principal uses of the ores and salts have been in ceramics, glassware, air conditioning, and pharmaceuticals. Lithia is a powerful flux, particularly when used with feldspar, and is usually added to ceramic batches in the form of lithium carbonate, less often as ground spodumene or lepidolite. It improves the gloss, strength, and weathering-resistance of glazes. Relatively small quantities of lithia in glass insure working fluidity without sacrificing desirable physical and chemical properties. As ceramic bodies containing spodumene generally expand on firing, this property can be used to neutralize shrinkage exactly, and porosity can be reduced by a sintering operation in processing the raw material. A spodumene feldspar mixture that fuses at 6 or 7 pyrometric cone equivalents below the fusion temperature of pure feldspar has been placed on the market by the United Feldspar & Minerals Corporation, Spruce Pine, N. C., under the trade name Lithospar; the material is derived from pegmatites at Kings Mountain, N. C. A similar product is available from Tinton, in the Black

Hills of South Dakota. Additions of lepidolite mica afford a convenient source of alumina for opal or flint glass and increase the index of refraction and the toughness of the product. Amblygonite is rarely used directly in glassware or ceramics. Owing to its relatively high lithia content, this mineral is a preferred material for making lithium salts. A small amount of mixed lithium chloride and fluoride is used in welding-rod coatings.

The three principal shippers of lithium minerals and salts in 1941 were the American Potash & Chemical Co., producers of lithium-sodium phosphate from brines at Trona, Calif.; the Black Hills Keystone Corporation, whose output is largely lepidolite from the Black Hills of South Dakota; and the Maywood Chemical Works of Maywood, N. J., also working Black Hills pegmatites but recovering spodumene. The high price of lithium-sodium phosphate raises considerably the average price per ton of total lithium products shipped in the United States.

Use of lithium for high-conductivity copper castings more than doubled in 1941 compared with 1940, and its use in special bronzes is

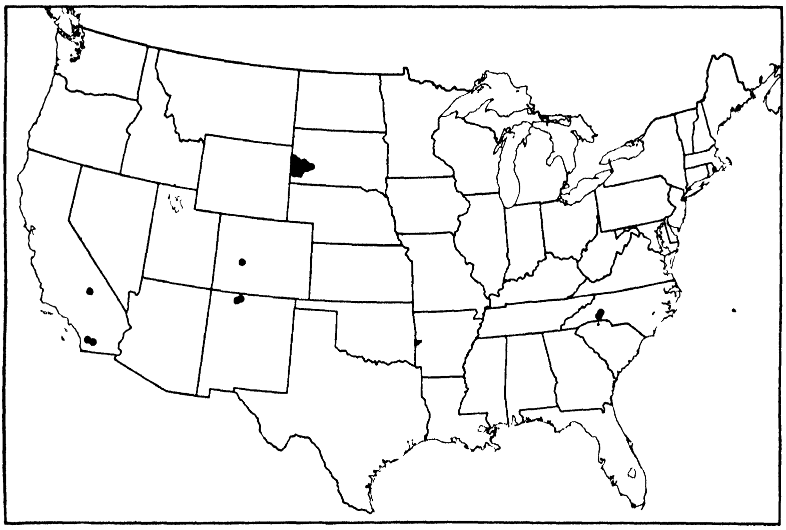

FIGURE 2.—Occurrence of lithium minerals in the United States.

now on a commercial scale. The element is added either in the form of a 50-50 lithium-calcium alloy or as an alloy of 98 percent copper and 2 percent lithium.[5]

Only small quantities of lithium minerals enter the open market. Nominal prices quoted by Engineering and Mining Journal Metal and Mineral Markets were unaltered during 1941 and for spodumene were \$5 per 20 pounds of contained lithia (Li_2O), 6 percent minimum, relatively iron-, quartz-, and tourmaline-free. Lepidolite, ordinary grade, lump, was quoted at \$24 to \$25 a short ton f. o. b. mine. Amblygonite, 8 to 9 percent Li_2O, was priced at \$40 a ton f. o. b. mine.

[5] Jeffries, Zay, Rare and Precious Metals Min. and Met., vol 23, No. 422, February 1942, p. 69.

MINERAL WOOL

Notwithstanding an estimated increase of 40 percent in dollar sales in 1941 over 1940, existing mineral-wool plants were able to handle the business. No new plants were completed during the year, although one was reported to be under construction in Missouri and another to be contemplated in Georgia. Unit prices of products were unchanged. The year-end forecast was for continued expansion, especially in pneumatic treatment of homes already built, due to fears of fuel shortage as well as to growing recognition of the true economy of insulation. Air-raid preparations also emphasized the fire-retarding properties of mineral wool. War Production Board orders to conserve metal for heating plants virtually required insulation of all new homes, heat losses being limited to 66 B. t. u. per square foot of floor area per hour per degree difference between inside and outside temperature.

MONAZITE

Formerly the only commercial constituent of monazite was thoria, which was used in gas mantles, and monazite is still marketed upon the basis of its thoria content, although commercial interest now centers on its content of ceria and other rare earth oxides. Probably 50 percent[6] of monazite derivatives are consumed (chiefly as fluorides) in the cores of arc carbons to increase lighting intensity in motion picture projectors, therapeutic lamps, and searchlights—in about that order. Pyrophoric alloys for use in sparking flints for cigar lighters take about 25 percent of the monazite consumed, and the remainder is distributed among a large variety of specialty uses, principally optical glassware. A summary of uses has been published elsewhere.[7]

The Consolidated Operations Corporation (reorganized in 1941 as Riz Mineral Co., 505 Park Street, West Palm Beach, Fla.) produced a small quantity of byproduct monazite in 1941 from rutile-ilmenite-zircon operations near Melbourne, Fla.

Nominal prices quoted by Engineering and Mining Journal Metal and Mineral Markets remained throughout 1941 at $60 a short ton ex-dock, 8 percent minimum thoria.

Beach deposits of black sands in Travancore in British India, along the coasts of Espirito Santo, Rio de Janeiro, and Bahia in Brazil, and in Netherlands Indies have supplied the bulk of United States monazite requirements in the past, as a byproduct in the recovery of ilmenite, rutile, and zircon sands. World production has been approximately 4,000 to 5,000 tons annually in recent years, British India furnishing over 80 percent and the remainder divided about equally between Brazil and Netherlands Indies. However, monazite has been produced from stream sands in the Piedmont region of the Carolinas, in Florida, and in Idaho. The domestic sands are lean and normally cannot compete with the Indian concentrates (8.8 to 10.1 percent thoria—ThO_2) or with Brazilian monazite (6 percent thoria). As mixed sands are imported under the same classification as high-purity monazite, the import statistics for different years are not always comparable.

[6] O'Neill, Leo J., Monazite: Bureau of Mines Mineral Trade Notes, vol. 13, No. 1, July 19, 1941, p. 20.
[7] Harness, Charles L., Rare Earths: Bureau of Mines Mineral Trade Notes, vol. 13, No. 3, September 20, 1941, pp. 26–28.

Monazite sand and other thorium ore imported into the United States for consumption, 1937–41 [1]

Country of origin	1937		1938		1939		1940		1941 (Jan.–Sept.)	
	Short tons [1]	Value	Short tons [1]	Value	Short tons [1]	Value	Short tons [1]	Value	Short tons [1]	Value
Brazil			110	$3,421	54	$1,516	201	$7,440	411	$14,440
India, British			339	14,402	1,336	46,753	2,766	92,387	1,146	37,468
Netherlands Indies	336	$13,579			170	3,747				
United Kingdom			7	387						
Total	336	13,579	456	18,210	1,560	52,016	2,967	99,827	1,557	51,908

[1] Quantities are gross weight; monazite content not reported.

OLIVINE

Shipments of olivine in 1941 rose to 4,828 short tons valued at $24,401, the highest tonnage since 1936. With the exception of a small quantity used in the production of Epsom salt, the entire output was consumed in refractories.

A review of olivine deposits of North Carolina and Georgia [8] estimates reserves of 230,000,000 short tons of high-grade forsterite olivine in the area, averaging 48 percent MgO. Domestic developments during 1941 have been reported elsewhere.[9]

Engineering and Mining Journal Metal and Mineral Markets in 1941 quoted crude North Carolina olivine at $5 to $7 a short ton at works; ground 200-mesh, $17 a ton; and 20-mesh to dust, $12 a ton.

QUARTZ CRYSTAL

Modern mechanized warfare depends upon instantaneous two-way radio communication, which to be effective must rely upon accurately ground wafers of crystal, two in each circuit; dozens are needed for a single tank or airplane. Brazil remains the only known commercial source of quartz suitable for radio-frequency control, and radio quartz crystal has been classified as a strategic mineral by the Army and Navy Munitions Board.

Quartz crystals of commercial size, found near Hot Springs, Ark., almost without exception show twinning, and crystal plates made from them do not have piezoelectric properties unless the twinned portion is cut away—a costly process. Cracks and inclusions of other minerals and of air render most domestic crystals and fragments subject to rejection, even before examination for piezoelectric properties.

In Brazil, the annual production of quartz crystal jumped to over 1,000 short tons in 1940 from about 250 tons in 1937. One-fourth of the output is consumed as piezoelectric (radio) quartz, and the remainder is used as optical, instrument, or fusing quartz. Before 1941 Japan's purchases were the backbone of the Brazilian crystal industry. The United States had comparatively small peacetime requirements and bought only high-grade material.

In 1941 the Governments of the United States and Great Britain agreed to buy all stocks of Brazilian quartz crystals remaining after

[8] Hunter, Charles E., Forsterite Olivine Deposits of North Carolina and Georgia: North Carolina Dept. Conservation and Development Bull. 41, 1941, 117 pp.
[9] Harness, C. L., Olivine Developments in 1941: Bureau of Mines Mineral Trade Notes, vol. 14, No. 4, April 20, 1942, p. 26.

their nationals had made purchases for private industry. The Brazilian Department of Mineral Production, Ministry of Agriculture, introduced export control through licenses and levied a 10-percent tax based upon export prices. Exports may clear only through the ports of Rio de Janeiro and Salvador.

A schedule of prices for the various grades of crystal as of April 1941 has been reported.[10] For example, "A" (piezoelectric) grade crystals weighing 1.5 to 2.0 kilograms with growth faces were quoted at 250,000 milreis a kilogram (about $6, United States currency, a pound). Owing to tremendous increases in demand and slight revision in specifications for oscillator plates, many of the manufacturers began to use smaller crystals down to 200 grams each. Prices of larger crystals advanced as much as threefold during the year, but even at the peak these represented only a minor factor in the cost of the final product.

STRONTIUM MINERALS

Wartime requirements of strontium salts for tracer bullets and signal flares, superimposed upon increased civilian requirements for railway fusees and for superpurification of caustic soda for rayon manufacture, created a market in 1941 for celestite producers on the West coast, where the mines had been virtually idle since 1918. The total shipments of strontium minerals in 1941 amounted to 4,724 short tons valued at $69,054 compared with less than half that quantity in 1940. In peacetime, virtually all the strontium ore consumed in the United States has been British celestite, owing to its greater purity and the cheaper freight rates for ocean than for rail transport. Import data for the first 9 months of 1941 indicate increased receipts of celestite from England and substantial quantities from Mexico—a new source—the total imports in that period being 3,172 short tons valued at $49,367 compared with the 12-month receipts in 1940 of 2,751 tons valued at only $28,686.

The outstanding producer of strontium minerals sold for chemical purposes was the Pan Chemical Co., 205 First National Bank Building, Pomona, Calif., which worked an open-pit deposit near Westmoreland, Imperial County, Calif. Crude ground celestite for use in drilling-mud admixes was produced by three Texas firms in 1941: The Bennett-Clark Co., Inc., Nacogdoches (deposit at Sweetwater, Nolan County); the Milwhite Co., Inc., of Houston (deposit at Blanket, Brown County); and Mudrite Chemicals, Inc. (deposit at Blanket). Strontianite was produced by the Manufacturers Mineral Co., Seattle, Wash. (mine at La Conner, Wash.), and by C. Solomon of San Francisco, Calif. (mine at Barstow, Calif.).

A general review of the strontium-minerals industry was published by the Bureau of Mines in February 1942.[11]

TOPAZ

Promising results are being obtained in substituting properly calcined topaz for kyanite in refractories. The massive deposit in Chesterfield County, S. C., is now estimated to contain at least 60,000 tons of commercial topaz.

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[10] Bureau of Mines Mineral Trade Notes Vol 13, No 3, September 20, 1941, pp 25-26

[11] Harness, C L, Strontium Minerals Bureau of Mines Inf Circ 7200, 1942, 17 pp

VERMICULITE

Vermiculite was shipped by six operators in 1941, and sales of crude and refined material totaled 23,438 short tons valued at $125,444 at works, compared with 22,299 tons valued at $137,698 in 1940 (revised figures). The Universal Zonolite Insulation Co. (2601 West 107th Street, Chicago, Ill.), operating properties at Libby, Mont., remains the predominant producer and processor, with 47 plants, although smaller producers have developed local markets.

Standard uses for expanded (heat-treated) vermiculite are as house fill; in insulating, acoustical, and lightweight plasters; in cements; and in coatings. When ground it may be used in aluminum and bronze powder paints as an extender or replacement, and this outlet may be developed further in view of metal shortages.

North Carolina reserves of commercial-grade vermiculite have been estimated [12] at 250,000 to 500,000 tons. Recent tests by the University of North Carolina laboratories indicate that local vermiculites are equivalent to and interchangeable with the western product. Houses using precast North Carolina vermiculite wall panels and vermiculite concrete flooring were erected in 1941. In St. Louis, Mo., poured slabs of vermiculite concrete were used successfully in the roof of a large, new, small-arms factory; 180 carloads of vermiculite were used on this job alone. In North Carolina, vermiculite fines have been used ni the inner soles of shoes.

Little or no run-of-mine vermiculite enters the domestic market. Virtually all is screened and cleaned at the mine, and some is exfoliated by the producer or may be sold to a processor for heat treatment. Screened vermiculite from Montana and Wyoming operations was sold to processors at $5 to $10 a short ton f. o. b. mine. Screened North Carolina vermiculite was sold at $10 to $15 a short ton f. o. b. mine. Western exfoliated material was quoted at $40 to $55 a short ton and North Carolina at $35 to $45 f. o. b. works.

[12] Murdock, T. G., Vermiculite Mining in North Carolina: Paper presented at meeting of Am. Inst. Min. and Met. Eng., New York, N. Y., February 9, 1942.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. ADAMS

SUMMARY OUTLINE

INTRODUCTION

Employment in nearly all branches of the mineral industry of the United States made gains during 1941, according to information sent by operating companies to the Bureau of Mines. Although reports received thus far do not cover all active operations, they reveal that of the 22 groups of mineral industries for which separate figures have been compiled 17 groups employed more men and 20 worked a larger aggregate number of man-hours than in 1940; these 22 classes are listed in an accompanying table. As far as can be judged from information now available, the only groups that experienced a reduction in total employee-hours worked during 1941 were gold placer mines and marble quarries, both of which apparently suffered a loss in number of employees and in man-hours worked.

The increase in number of employees and in total man-hours of work performed during the year were natural results of war demands for mineral products.

With larger volume and accelerated tempo of work came a larger number of injuries from accidents to employees. Fortunately, the number of fatal accidents decreased; the number of nonfatal lost-time injuries was larger than in 1940. The gain in man-hours worked, however, prevented a large rise in the accident-frequency rate (number of accidents per million man-hours of work) which was only slightly higher in 1941 than in 1940. The rate for fatal accidents was reduced, so the slight increase in total accident frequency was solely in the rate for nonfatal injuries.

A review of employment and accidents in the mineral industries of the United States for the 11 years 1931-41 shows that the number of employees reached a maximum in 1937. The maximum volume of

employment, as measured by man-hours of work performed, however, was attained in 1941, according to estimates based upon the latest available information; this achievement may doubtless be attributed to work required to supply domestic and foreign demands that can only be met, directly or indirectly, by greater production of minerals in the world's largest mineral-producing nation.

Number of men employed in the mineral industries of the United States, 1939–41

	1939	1940	1941 [1]
Coal mines:			
Bituminous	445,044	440,847	448,000
Pennsylvania anthracite	94,331	92,420	88,900
	539,375	533,267	536,900
Metal mines:			
Iron	19,769	23,250	23,800
Lead-zinc (Mississippi Valley)	7,237	7,644	7,900
Copper	18,436	19,498	21,500
Gold and silver lode mines (including lead, zinc, and copper, except as listed above)	38,439	39,128	39,900
Gold placer mines	14,775	15,701	15,500
Miscellaneous (tungsten, manganese, etc.)	3,623	5,119	5,400
	102,279	110,340	114,000
Nonmetallic-mineral mines	9,630	9,780	10,600
Quarries:			
Cement	26,045	26,695	28,600
Marble	3,697	3,240	2,500
Slate	2,833	2,800	2,700
Traprock	2,771	2,951	2,700
Granite	8,390	7,162	7,300
Sandstone	3,113	3,078	3,400
Limestone	22,968	23,251	25,100
Lime	9,632	10,332	11,100
	79,449	79,509	83,400
Coke ovens:			
Byproduct	14,852	17,469	18,600
Beehive	1,757	2,493	4,000
	16,609	19,962	22,600
Metallurgical plants:			
Mills	12,476	13,990	14,400
Smelters	15,905	20,120	21,300
Auxiliary works	13,202	14,958	16,500
	41,583	49,068	52,200
Grand total	788,925	801,926	819,700

[1] Subject to revision.

The following table presents annual figures from 1931 to 1941 covering number of employees, number of man-days and man-hours worked, and number of men killed and injured by accidents, as well as the yearly fatality and injury rates for the mineral industries—mines, quarries, coke ovens, ore-dressing plants, smelters, and auxiliary works connected with ore-dressing plants and smelters. Figure 1 graphs these trends from 1932 to 1941.

Employment and accident record of mineral industries of the United States, 1931–41

Year	Men employed	Man-days of employment	Man-hours of employment	Number		Rate per million man-hours	
				Killed	Injured	Killed	Injured
1931	784,347	147,602,799	1,209,270,036	1,707	96,412	1.41	79.73
1932	671,343	110,655,616	900,211,723	1,368	68,717	1.52	76.33
1933	677,722	122,787,658	984,570,160	1,242	72,342	1.26	73.48
1934	739,817	144,566,133	1,081,694,716	1,429	81,660	1.32	75.49
1935	783,139	152,354,170	1,128,808,465	1,495	82,219	1.32	72.84
1936	824,514	177,920,334	1,326,347,029	1,686	92,644	1.27	69.85
1937	859,951	186,790,283	1,381,261,415	1,759	96,484	1.27	69.85
1938	774,894	145,056,875	1,069,729,725	1,369	71,618	1.28	66.95
1939	788,925	159,388,490	1,169,351,497	1,334	75,495	1.14	64.56
1940	801,926	175,663,792	1,293,131,693	1,716	82,861	1.33	64.08
1941 [1]	819,700	191,426,000	1,405,113,000	1,620	91,188	1.15	64.90

[1] Subject to revision.

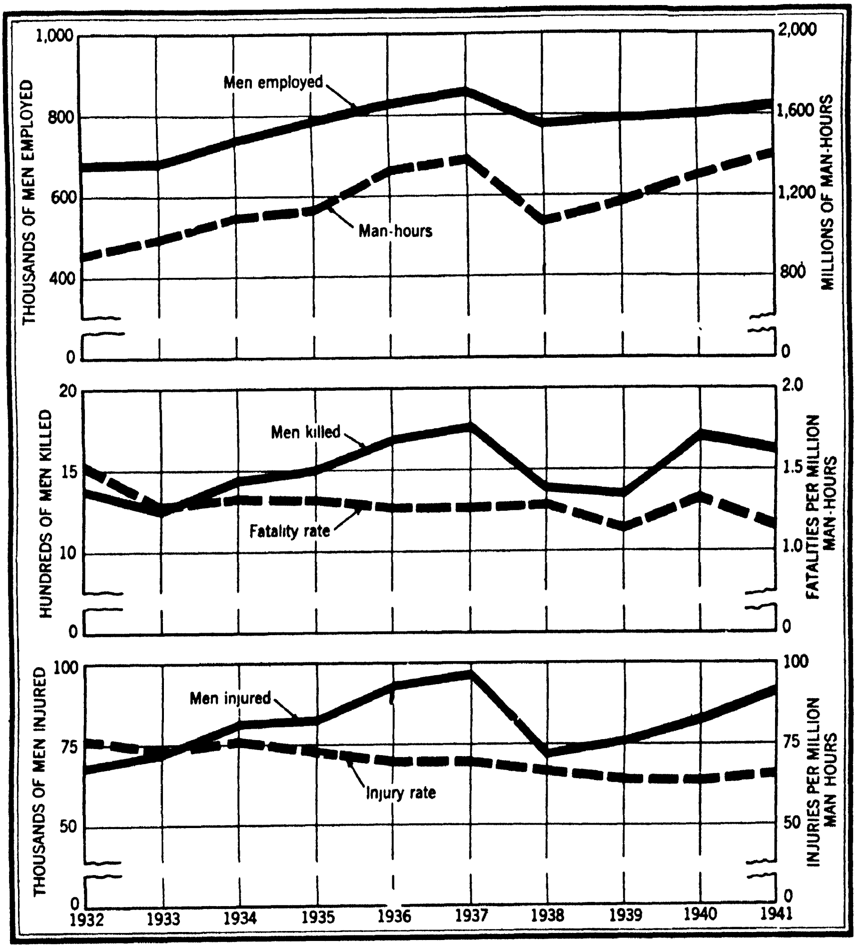

FIGURE 1.—Trend of employment and fatal and nonfatal accidents in the mineral industries of the United States, 1932–41.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—About 666,000,000 man-hours of work were required to furnish the United States with approximately 504,577,000 short tons of bituminous coal in 1941. This work was done by a labor force estimated at 448,000 men. The mines were in operation for about 213 days per man. Seven hours was the standard daily work shift. These estimated figures indicate an increase of about 43,000,000 tons in production, of about 7,000 employees, and of the work year by an average of 12 days per man.

Accidents.—Although fatal accidents (now estimated at 1,064) were less numerous during 1941 than in 1940, the estimated number of nonfatal injuries to employees rose from nearly 44,000 to more than 47,000; and the larger number of nonfatal accidents caused a small increase in the rate per million man-hours of exposure, as the tentative rate was 71 in 1941 compared with 70 in 1940. The year 1941 was marked by 2 more major disasters in the mines than in the preceding year—8 compared with 6 in 1940; however, 73 men were killed by major disasters in 1941 compared with 276 in 1940.

The eight major disasters during 1941 were not confined to any particular State; two occurred in Illinois, two in Alabama, and one each in West Virginia, Kentucky, Pennsylvania, and Indiana. All the major disasters were explosions except the one in Illinois, which was due to explosives.

Even though 1941 had two more major disasters than 1940, the over-all fatality rate from all causes was only 1.60 per million man-hours of exposure, indicating a much better record in this respect than in 1940, when the rate was 1.92.

More than half of the total number of workers at all classes of mines and quarries are employed in bituminous-coal mines. Four-fifths of all fatal accidents and three-fourths of all nonfatal accidents in the mineral industries also occur at bituminous mines. Special importance therefore attaches to the accident record of the industry that has such a determining influence on the over-all accident costs incident to the production and development of the mineral resources of the United States.

Yearly records of fatal accidents at bituminous-coal mines are available for all States, covering all years beginning with 1910, and for the principal coal-producing States back to 1906. Similar records on nonfatal accidents are available only since 1931. These records show that the chief cause of both fatal and nonfatal accidents is falls of roof and coal. The actual number of deaths and injuries from this hazard has been greatly reduced, but the accident rates per million man-hours do not show an equal decline because the number of employees and man-hours has also been reduced. The reduction in employment without an equal loss in production of coal has been made possible by the rapid mechanization of many operations that formerly were carried on by hand or with hand-operated tools, such as drills, picks, and shovels. Productivity per man-hour worked has therefore increased, and the coal industry has been able to supply the fuel needs of the country with fewer men exposed to the accident hazards of mining. Simultaneously, accident-prevention programs of mining companies have been effective in reducing the number of accidents;

but the reduction in accidents has resulted in only a slight downward trend in accident rates per million man-hours of exposure over a period of years. An important factor inherent in any Nation-wide effort to reduce the per-million-man-hour accident rate from falls of roof and coal is the difficulty attending the safety training of around 300,000 men in the mines, the employees at the "working face," who, more than other classes of underground employees, are exposed to the falls-of-roof hazard.

Haulage accidents rank next to falls of roof among the occupational hazards to which coal miners are exposed. The long-time trend of accident rates for accidents of this class is upward. Contributing causes are probably the lengthening of haulageways following the extension of mined-out areas underground and the use of larger cars and their more rapid movement because of increasing productivity per man-hour of labor incident to the replacement of hand methods by machine methods of work; thus production is being accelerated without a corresponding increase in the intensity and scope of accident-prevention methods and installation of safety appliances. The vital part of haulage operations in the production of coal and the upward trend in accidents that involve haulage equipment suggest the importance of special study by mining companies and others of means whereby haulage accidents to the mine workers may be reduced.

Fortunately, gas and dust explosions that occurred so often and on so large a scale in earlier years have been greatly reduced in frequency and severity, both absolutely and in relation to the number of man-hours of exposure to risk. Even in recent years, such explosions have occurred all too frequently, but the progress made by the coal industry in preventing loss of life from this class of accidents will become apparent to anyone who examines the record of the coal-mining industry.

Accidents directly chargeable to explosives have likewise been greatly reduced, both absolutely and relatively. Much of this improvement may be credited to the adoption of "permissible" explosives by mines that formerly used more dangerous types of explosives, usually black blasting powder.

Electricity, although not the chief mining hazard because relatively few accidents result from its use compared with those from haulage and from falls of roof, is nevertheless among the risks to which coal miners are exposed because of its major role as a source of power for operating mining machines and mine haulage motors. The fatality rate from electricity, though not as high as those for roof falls and haulage, is higher than it was when electric current was used less extensively in mining. The increasing application of electric power in coal mines demands special study by safety engineers.

ANTHRACITE MINES

Employment.—This group includes all mines in the eastern part of Pennsylvania that produce coal generally known as "hard coal" or "anthracite." Output from legitimate mines, as distinguished from so-called "bootleg" operations, amounted to about 54,000,000 short tons in 1941 and required the work of approximately 88,900 men for 130.1 million man-hours. According to tentative figures now available, the number of employees was slightly less than in 1940 but

the total man-hours worked was greater. The average employee worked about 18 workdays more than in 1940.

Accidents.—Accidents to men working in and about the mines and breakers caused 194 fatalities and 16,828 nonfatal lost-time injuries. Final reports for 1941 probably will show a fatality rate of about 1.49 and a nonfatal-injury rate of about 129 per million man-hours worked. The combined accident frequency rate is slightly less favorable than that of 1940. No major disaster occurred in 1941; in fact, no major disaster has occurred in an anthracite mine since June 2, 1938, when 10 men were killed in an explosion in a mine in Luzerne County.

IRON-ORE MINES

Employment.—The demand for iron to meet the needs of American industry in the general war program of the United States continued to move the trend of employment at iron-ore mines upward during 1941. Incomplete reports from operators indicate a 15-percent increase in man-hours worked. The gain in number of men employed was relatively small, as the estimated number of employees in 1941 was 23,800 compared with 23,250 in 1940. In 1941 the average employee worked 275 days and thus had 32 more days of employment than in 1940. Man-hours of labor in 1941 numbered about 52,000,000.

Accidents.—Available reports indicate that 45 men were killed by accidents at iron-ore mines during 1941; 35 men were killed during 1940. Reports for 1941 also indicated that 1,158 employees received nonfatal injuries that caused them to lose time from their work. The accident-frequency rate rose from 19.63 in 1940 to 23.08 (tentative) in 1941. These figures include a fatality rate of 0.77 in 1940 and 0.86 in 1941. Among the major metal-mining industries in the country, iron-ore mines consistently report the lowest accident-frequency rate. The preponderance of open-cut mines in Minnesota is partly responsible for this favorable record, although the unflagging prosecution of safety programs by the operating companies is doubtless the most potent factor.

COPPER MINES

Employment.—Reports for copper mines in 1941 showed continued gains in number of employees and man-hours worked. Approximately 21,500 men were engaged in mining copper ore, and they labored approximately 55,000,000 man-hours during the year. These figures relate to mines whose chief product was copper; they do not cover mines whose ores, though containing some copper, were valuable chiefly because of their content of some other metal. Judging from reports now available, the workyear 1941 averaged 319 days per man, an increase of 7 days for the average worker. The total man-hours worked in the industry as a whole represent a 13-percent gain over 1940.

Accidents.—The increased employment in 1941 brought in its train a larger number of accidents to employees. The fatality rate, as at present estimated, was 1.11 compared with 0.99 in 1940; the tentative rate for nonfatal injuries was 53.14 compared with 52.91. Sixty-one of the accidents in 1941 resulted fatally; an estimated 2,920 were nonfatal lost-time injuries.

LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

Employment.—This group comprises all lead- and zinc-producing mines in the Mississippi Valley States, chiefly Oklahoma, Missouri, and Kansas; it also includes mines in Illinois and Kentucky that produce fluorspar. Fluorspar mines in these two States are included for two reasons: First, it is desirable to maintain unbroken a statistical series in the Bureau of Mines accident records that extends back to 1911. Second, natural conditions regarding safety are similar in the two classes of mines in the States named. Therefore, by combining the two classes of mines, the number of operating companies becomes large enough to permit separate figures to be published for Illinois and Kentucky. With this explanation, it may be stated that mines in the Mississippi Valley States employed about 7,900 men in 1941, an increase over the 7,644 men employed in 1940. Man-hours of employment rose from 13.7 million in 1940 to 16.4 million in 1941, or more than 19 percent. The average employee had a longer workyear than in 1940.

Accidents.—From reports now available, the accident-frequency rate for 1941 appears to have been 52.08 per million man-hours, which compares favorably with the rate of 56.92 for 1940. The rate for 1941 is based upon an estimate of 855 injuries, including 19 fatalities.

GOLD AND SILVER MINES (LODE AND PLACER)

Employment.—This group includes not only mines that were operated chiefly for the gold or silver contained in their ores but also lead and zinc mines outside the Mississippi Valley States and mines that produced some copper but whose ores were valuable chiefly because they contained metal other than copper. Placer mines as well as lode mines are included in the group.

The group as a whole employed about 55,400 men in 1941 compared with 54,829 in 1940. Man-hours of employment increased from 94.1 to 95.4 million. The fact that the group did not show a loss in employment probably can be attributed to the inclusion of mines whose ores contained some copper, zinc, or lead.

Accidents.—Tentative figures now available reveal that the accident-frequency rate for this group of mines was 102.55 per million man-hours, which compares unfavorably with the rate of 97.43 for 1940. Accidents during 1941 caused injuries estimated at 9,784, including 103 fatalities

MISCELLANEOUS METAL MINES

Employment.—This group includes all mines that produce metallic ores exclusive of gold, silver, copper, lead, zinc, and iron; these mines yield such strategic minerals as tungsten, mercury, manganese, bauxite, and molybdenum, as well as various other metals. Tentative figures now available suggest that war production was an influencing factor in raising the employment figures in 1941 to approximately 5,400 men, or more than 5 percent above the 5,119 men employed in 1940. The man-hours of employment rose from 10,000,000 to nearly 12,000,000, or more than 19 percent.

Accidents.—The safety record for mines in the "Miscellaneous metal-mines" group was less favorable in 1941 than in 1940. The accident frequency rate per million man-hours of employment rose to approximately 74.32 from 68.87 in 1940, including a fatality rate of 0.80 in 1940 and an estimated fatality rate of 1.25 in 1941.

NONMETALLIC-MINERAL MINES

Employment.—This group comprises mines that yield any kind of nonmetallic mineral except coal, stone, sand, gravel, and clay. It therefore includes mines that produce phosphate rock, rock salt, sulfur, gypsum, feldspar, barite, and many other minerals. Employment in 1941 was 10,600 men, an 8-percent increase over the 9,780 men employed in 1940; whereas the man-hours of employment in 1941 totaled 22,000,000 compared with 19,000,000 in 1940, an increase of approximately 17 percent.

Accidents.—Tentative figures to date reveal that the accident-frequency rate for 1941 was 48.64 per million man-hours worked; this compares unfavorably with the rate of 44.24 for 1940.

CEMENT MILLS AND QUARRIES

Employment.—Increased employment was reported in the cement industry in 1941; approximately 28,600 men were employed, or 7 percent more than in 1940. The men worked an estimated 63,000,000 man-hours, an increase of 15 percent. The men averaged 305 days of employment during the year and thereby gained 27 days per man over the average work period in 1940.

Accidents.—The rise in employment at cement plants in 1941 was accompanied by an increase in the total number of accidents to employees; 14 men were killed, and about 692 were injured. These accidents resulted in a fatality rate of 0.22 per million man-hours of employment, a decrease from the previous year's rate of 0.27. The nonfatal-injury rate was 10.90 per million man-hours compared with 9.44 in 1940.

MARBLE QUARRIES

Employment.—Employment at marble quarries and related operations continued the downward trend in employment that began in 1940. An estimated 2,500 men were employed, or more than 700 men less than the total of 3,240 in 1940. Man-hours of employment amounted to approximately 4.9 million, a decrease of 19 percent from 1940.

Accidents.—Preliminary figures indicate that no fatalities occurred in the marble industry during 1941. Although the number of accidents probably will show little change from 1940, the accident-frequency rate per million man-hours of employment will show a decided increase because of the large drop in man-hours worked The rate for 1941 is estimated at 49.70 compared with 40.82 for 1940.

SLATE QUARRIES

Employment.—Although the number of men employed in the slate industry decreased in 1941, according to preliminary figures, the number of man-hours of employment increased, indicating a longer workyear per man. It is estimated that 2,700 men worked 5.4 million

man-hours and that the average employee had 19 more workdays during 1941 than during 1940.

Accidents.—One man was killed and 330 were injured in 1941 in the course of their employment. The fatality rate for 1941 was 0.19 and the nonfatal-injury rate 61.46, corresponding rates for 1940 being 0.20 and 70.83, respectively.

TRAPROCK QUARRIES

Employment.—The traprock industry employed 2,700 men in 1941, according to preliminary reports to the Bureau of Mines. These men worked 4.9 million man-hours. The man-hours of employment represent a gain of about 15 percent over the 1940 total compared with a loss of nearly 9 percent in the number of employees.

Accidents.—Four men were killed in 1941. Approximately 334 men suffered nonfatal lost-time injuries from accidents during their employment. The fatality rate was 0.82 and the nonfatal-injury rate 68.08, compared with 0.70 and 62.94, respectively, in 1940.

GRANITE QUARRIES

Employment.—Employment at granite quarries rose in 1941 over 1940, according to preliminary figures; about 7,300 men were employed, an increase of approximately 2 percent. These men worked an average of 238 days each, or 15 more days per man per year than in 1940. The number of man-hours worked reached approximately 14,000,000, a gain of 14 percent.

Accidents.—Nine men were killed and 694 injured, resulting in a fatality rate of 0.64 per million man-hours of exposure and a nonfatal rate of 49.51. Although the fatality rate in 1941 was lower than the rate of 0.98 in 1940, the nonfatal-injury rate increased over the rate of 44.26 in 1940.

SANDSTONE QUARRIES

Employment.—The number of men employed at sandstone quarries and related plants increased in 1941, the tentative figure being 3,400 compared with 3,078 in 1940. Man-hours of work also made a substantial gain and totaled 6,000,000, a considerable advance (24 percent) over the 4.9 million hours worked in 1940. The average days of employment also increased, apparently about 26 days per man over the average of 199 workdays per man in 1940.

Accidents.—Accidents in sandstone quarries resulted in 2 deaths among the employees, giving a fatality rate of 0.31 per million man-hours of exposure to risk. It is estimated that 348 nonfatal injuries occurred among the employees. This estimate indicates an injury rate of 57.48 compared with 50.80 for 1940.

LIMESTONE QUARRIES

Employment.—The number of men employed in limestone quarries was 8 percent greater than in 1940, or an estimated total of 25,100 men; these figures do not include employment at limestone quarries at which the stone was used in manufacturing cement or lime. The man-hours of employment increased 20 percent, or in larger proportion than the men employed. A total of nearly 45,000,000 man-hours was worked during 1941 compared with 37,000,000 in 1940.

Accidents.—Accidents caused the death of 24 men and nonfatal lost-time injuries to approximately 2,436. The combined accident-frequency rate for 1941 was 55.01, and for 1940 it was 53.10.

LIMEKILNS AND QUARRIES

Employment.—Men employed, man-days, and man-hours at quarries producing limestone for the manufacture of lime increased in 1941, according to preliminary reports from operating companies to the Bureau of Mines. Approximately 11,100 men were employed for a total of more than 24,000,000 man-hours. The average number of days of work per man differed little in 1941 from 1940.

Accidents.—Accidents increased in greater proportion than employment, as revealed by an accident-frequency rate of 63.61 compared with 47.60 in 1940. The 1,565 accidents estimated for 1941 included 15 fatalities and 1,550 nonfatal injuries.

BYPRODUCT COKE OVENS

Employment.—Employment at byproduct coke ovens advanced in 1941. Complete reports indicate that 18,600 men were employed and that nearly 54,000,000 man-hours were worked compared with 17,469 men and about 50,000,000 man-hours in 1940. The number of men employed was 6 percent greater and the number of man-hours of employment 7 percent greater than in 1940.

Accidents.—Twelve men were killed and 435 men injured at byproduct coke ovens in 1941. The fatality rate was 0.22 and the nonfatal-injury rate 8.07 per million man-hours of employment compared with 0.30 and 7.94, respectively, in 1940.

BEEHIVE COKE OVENS

Employment.—The number of men employed at beehive coke ovens in 1941 rose 60 percent to a total of 4,000. These men performed 7,000,000 man-hours of work during the year, or more than twice the hours worked in 1940. The number of employees at beehive coke ovens reached a higher figure in 1941 than in any year since 1926, and the number of man-hours of employment was greater than in any year since 1927.

Accidents.—For the first time since 1937, fatalities occurred during operations at beehive coke ovens. Three men were killed in 1941, and these accidents resulted in a fatality rate of 0.43 per million man-hours of exposure. In all, 367 men suffered nonfatal lost-time injuries, resulting in a nonfatal-injury rate of 52.71, which compares unfavorably with the 1940 rate of 44.00 per million man-hours.

ORE-DRESSING PLANTS

Employment.—Ore-dressing and beneficiating plants or mills employed approximately 14,400 men in 1941 compared with 13,990 in 1940. The plants, considered as a group, were in operation 33,000,000 man-hours; this figure reveals a 7-percent gain over the record of nearly 31,000,000 man-hours worked in 1940.

Accidents.—Accidents to men employed at the mills occurred at the rate of 27.38 per million man-hours, a rate that compares favorably with 31.99 in 1940.

SMELTERS

Employment.—The smelting industry, as the term is here used, covers the smelting and refining of all metallic ores except iron ore. Employment and accident statistics covering iron-ore smelting and steel manufacturing are collected and compiled by the United States Department of Labor and hence are not included in Bureau of Mines figures. The smelting industry, as thus defined, employed approximately 21,300 men in 1941, an increase of nearly 6 percent over the 20,120 men employed in 1940. The man-hours of employment totaled 53.4 million in 1941 compared with 46.8 million in 1940, an advance of 14 percent.

Accidents.—Accidents to men employed at smelters in 1941 occurred at the rate of 24.77 per million man-hours worked. As the corresponding rate for 1940 was 19.71, it is apparent that the safety record of 1941 was unfavorable.

AUXILIARY WORKS AT ORE-DRESSING PLANTS AND SMELTERS

Employment.—Auxiliary works cover all operations at mills and smelters not directly connected with milling and smelting processes. About 16,500 men were employed in 1941, 10 percent more than the 14,958 employed in 1940. Man-hours worked increased to 40.5 million from 35.3 million in 1940, or 15 percent.

Accidents.—Tentative figures reveal an accident-frequency rate of 22.88 per million man-hours in 1941. The 1940 rate of 19.44 indicates a less-favorable safety record in 1941. Accidents during 1941 are estimated at 927, including 10 fatalities.

SUMMARY, 1932–41

While the Nation is at war, loss of manpower in industry means loss of time needed to produce essential war materials. Accidents disabling employees in the mining, quarrying, and related mineral industries referred to in this chapter not only cost the men who work in these industries suffering and loss of income but also hamper the Nation in its effort to obtain maximum production of war materials. During 1941, for example, temporary injuries alone caused an estimated loss of approximately 3.3 million man-days to the war-production program of the United States when our country was aiding nations that after December 7 became our Allies. Additional losses were caused by accidents resulting in the death of injured employees and by other accidents causing permanent, total, or partial disablement. They cannot be stated in terms of man-days except in the customary way of considering that an industrial accident that kills an employee thereby destroys 6,000 days life-expectancy of usefulness in industry, that a similar loss results from each case of permanent total disability, and that some part of 6,000 days of usefulness in industry is destroyed by each case of permanent partial disability, the exact amount depending on the severity of injury and the part of the body affected. Usual methods of considering deaths and permanent injuries suggest a loss of more than 12,500,000 man-days because of such accidents during 1941. Thus, all classes of accidents in the mineral industries during 1941 may be fairly considered to have destroyed nearly 16,000,000

man-days of labor that might have otherwise contributed to the production of mineral commodities during the present war and, later, during the years of peace.

In bituminous coal-mining alone, and considering temporary injuries only, the loss of about 1.7 million man-days from accidents during 1941 meant that nearly 9,000,000 more tons of coal could have been produced in that year.

Losses of manpower such as those described here challenge the ingenuity of mine managers and the cooperative spirit of mine employees. Such losses, greater or less, are but every-year experiences in the United States, a fact demanding investigation at least equal in continuity and intensity to that often applied to problems apparently more important commercially.

The marked success that attends the accident-prevention programs of many mining companies indicates what may be accomplished by other operators in the saving of life and limb and in promoting contentment among the large group of Americans who have chosen the production of minerals as their life work. Both humanitarian and monetary considerations suggest that maximum effort of employees, operators, and Government be devoted to attaining these great objectives.

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